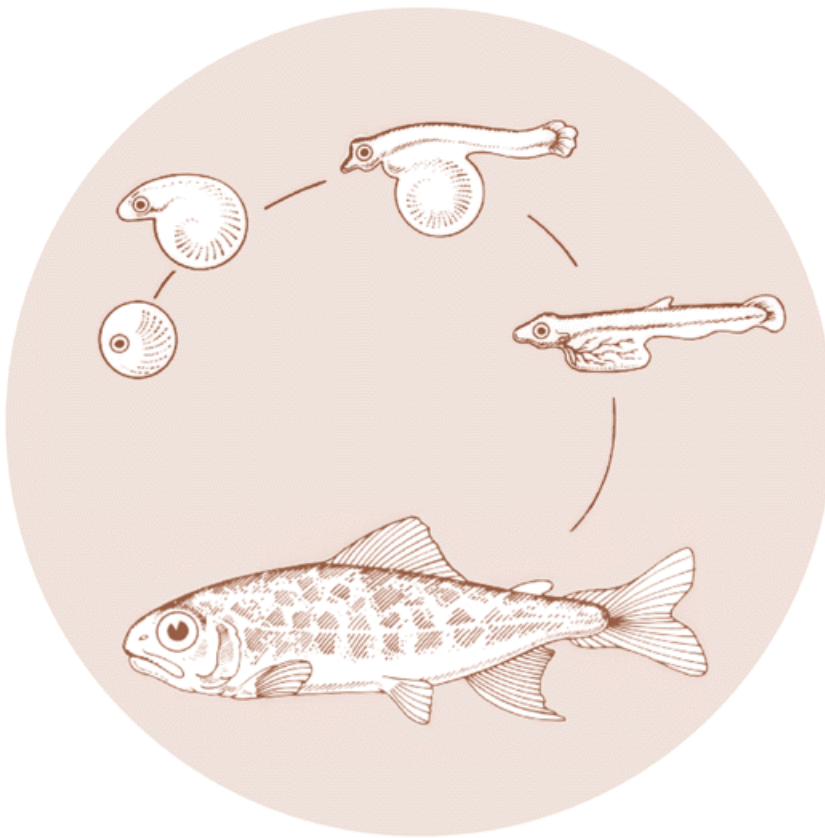


March 1994

ANNUAL CODED WIRE TAG PROGRAM (WASHINGTON) MISSING PRODUCTION GROUPS

Annual Report 1993



DOE/BP-01873-1



This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

Fuss, Howard J., R. Fuller, M. A. Kimbel, A. E. Appleby, S. A. Hammer - Washington Department of Fisheries, 1994, Annual Coded Wire Tag Program (Washington) Missing Production Groups, 1993 Annual Report 1993, Report to Bonneville Power Administration, Contract No. 1989BP01873, Project No. 198906600, 90 electronic pages (BPA Report DOE/BP-01873-1)

This report and other BPA Fish and Wildlife Publications are available on the Internet at:

<http://www.efw.bpa.gov/cgi-bin/efw/FW/publications.cgi>

For other information on electronic documents or other printed media, contact or write to:

Bonneville Power Administration
Environment, Fish and Wildlife Division
P.O. Box 3621
905 N.E. 11th Avenue
Portland, OR 97208-3621

Please include title, author, and DOE/BP number in the request.

ANNUAL CODED WIRE TAG PROGRAM (WASHINGTON)
MISSING PRODUCTION GROUPS

ANNUAL REPORT 1993

Prepared by:

Howard J. Fuss
Ross Fuller
Mark A. Kimbel
Andrew E. Appleby
Stanley A. Hammer

Washington Department of Fisheries

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97208-362 1

Project Number 89-66
Contract Number DE-B179-89BP0 1873

MARCH 1994

TABLE OF CONTENTS

ABSTRACT	1
INTRODUCTION	3
APPROACH	4
RESULTS	5
Objective 1	5
Objective 2	11
Objective 3	11
Grays River Hatchery	11
Elokomin River Hatchery	11
Toutle River Hatchery	12
Cowlitz River Hatchery	12
Lower Kalama Hatchery	12
Kalama Falls Hatchery	13
Lewis River Hatchery	13
Speelyai Hatchery	14
Washougal River Hatchery	14
Klickitat River Hatchery	14
Lyons Ferry Hatchery	15
Tucannon River Hatchery	15
Ringold Springs Hatchery	16
Priest Rapids Hatchery	16
Rocky Reach Hatchery	16
Wells Dam Hatchery	16

LIST OF TABLES

Table 1. Tagging summary and expenditures during FY-93 for 1991 brood yearling coho and chinook and 1992 brood subyearling chinook. Table includes those production groups tagged under contract with BPA. . . .	6
Table 2. Releases of 1992 brood subyearling fall chinook tagged during FY-93 under contract with BPA.	7
Table 3. Releases of 1991 and 1992 brood spring and summer chinook tagged during FY-93 under contract with BPA.	8
Table 4. Releases of 1991 brood coho tagged during FY-93 under contract with BPA.	9
Table 5. Releases of 1991 brood yearling chinook and coho and 1992 brood subyearling chinook during FY-93. This table represents groups tagged under other (non-BPA) funding sources.	10

LIST OF FIGURES

Figure 1. Survival of Grays River tule fall chinook by brood.	17
Figure 2. Survival of Grays River Type-S coho by brood.	18
Figure 3. Average percent contribution of Grays River Type-S coho to fisheries and escapement for broods 1988 and 1989.	19
Figure 4. Survival of Elokomin tule fall chinook by brood.	20
Figure 5. Survival of Elokomin Type-N coho by brood.	21
Figure 6. Average percent contribution of Elokomin Type-N coho to fisheries and escapement for broods 1988 and 1989.	22
Figure 7. Survival of Elokomin Type-S coho by brood.	23
Figure 8. Average percent contribution of Elokomin Type-S coho to fisheries and escapement for broods 1988 and 1989.	24
Figure 9. Survival of Cowlitz tule fall chinook by brood.	25
Figure 10. Average percent contribution of Cowlitz tule fall chinook to fisheries and escapement for broods 1986 and 1987.	26
Figure 11. Survival of Cowlitz spring chinook by brood.	27
Figure 12. Average percent contribution of Cowlitz spring chinook to fisheries and escapement for broods 1986 and 1987.	28
Figure 13. Survival of Cowlitz Type-N coho by brood.	29
Figure 14. Average percent contribution of Cowlitz Type-N coho to fisheries and escapement for broods 1988 and 1989.	30
Figure 15. Survival of Toutle tule fall chinook by brood.	31
Figure 16. Percent contribution to fisheries and escapement for 1987 brood Toutle tule fall chinook.	32
Figure 17. Survival of Toutle Type-S coho by brood.	33
Figure 18. Percent contribution to fisheries and escapement for 1989 brood Toutle Type-S coho.	34

Figure 19. Survival of Lower Kalama tule fall chinook by brood.	35
Figure 20. Survival of Lower Kalama Type-N coho by brood.	16
Figure 21. Survival of Lower Kalama Type-S coho by brood.	37
Figure 22. Average percent contribution of Lower Kalama Type-S coho to fisheries and escapement for broods 1988 and 1989.	38
Figure 23. Survival of Kalama Falls tule fall chinook by brood.	39
Figure 24. Survival of Kalama spring chinook by brood.	40
Figure 25. Survival of Kalama Falls Type-N coho by brood.	41
Figure 26. Average percent contribution of Kalama Falls Type-N coho to fisheries and escapement for broods 1988 and 1989.	42
Figure 27. Survivals of Lewis River wild fall chinook by brood.. . . .	43
Figure 28. Average percent contribution of Lewis River wild fall chinook to fisheries and escapement for broods 1986 and 1987.	44
Figure 29. Survivals of Lewis River Type-N coho by brood.. . . .	45
Figure 30. Average percent contribution of Lewis River Type-N coho to fisheries and escapement for broods 1988 and 1989.	46
Figure 31. Survivals of Lewis River Type-S coho by brood.	47
Figure 32. Average percent contribution of Lewis River Type-S coho to fisheries and escapement for broods 1988 and 1989.	48
Figure 33. Survival of Washougal tule fall chinook by brood.	49
Figure 34. Average percent contribution of Washougal tule fall chinook to fisheries and escapement for broods 1986 and 1987.	50
Figure 35. Survival of Washougal Type-N coho by brood.	51
Figure 36. Average percent contribution of Washougal Type-N coho to fisheries and escapement for broods 1988 and 1989.	52
Figure 37. Survival of Washougal Type-S coho by brood.	53
Figure 38. Average survival by brood of Washougal Type-N coho transported	

to the Klickitat River for release.	54
Figure 39. Average percent contribution to fisheries and escapement for broods 1988 and 1989 of Washougal Type-N coho transported to the Klickitat River	55
Figure 40. Survival of Klickitat fall chinook by brood.	56
Figure 41. Percent contribution of Klickitar fall chinook to fisheries and escapement for the 1986 brood.	57
Figure 42. Survival of Klickitat spring chinook by brood.	58
Figure 43. Survival of Klickitat Type-N coho by brood.	59
Figure 44. Average percent contribution of Klickitat Type-N coho to fisheries and escapement for broods 1988 and 1989.	60
Figure 45. Average survival by brood of Lyons Ferry (Snake River) subyearling fall chinook released on-station.	61
Figure 46. Average percent contribution of Lyons Ferry subyearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released on-station.	62
Figure 47. Average survival by brood of Lyons Ferry (Snake River) subyearling fall chinook released after barging downstream.	63
Figure 48. Average percent contribution of Lyons Ferry subyearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released after barging.	64
Figure 49. Average survival by brood of Lyons Ferry (Snake River) yearling fall chinook released on-station.	65
Figure 50. Average percent contribution of Lyons Ferry yearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released on-station.	66
Figure 51. Average survival by brood of Lyons Ferry (Snake River) yearling fall chinook released after barging.	67
Figure 52. Average percent contribution of Lyons Ferry yearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released after barging.	68

Figure 53. Average survival of Tucannon spring chinook by brood.	69
Figure 54. Average percent contribution of Tucannon spring chinook to fisheries and escapement for broods 1986 and 1987.	70
Figure 55. Survival of Ringold spring chinook by brood.	71
Figure 56. Survival of Priest Rapids upriver bright fall chinook by brood.	72
Figure 57. Average percent contribution of Priest Rapids fall chinook to fisheries and escapement for broods 1986 and 1987.	73
Figure 58. Survival of Rocky Reach upriver bright yearling fall chinook by brood.	74
Figure 59. Percent contribution of 1986 brood Rocky Reach upriver bright yearling fall chinook to fisheries and escapement.	75
Figure 60. Survival of Rocky Reach Type-S coho by brood.	76
Figure 61. Percent contribution of 1989 brood Rocky Reach Type-S coho to fisheries and escapement.	77
Figure 62. Survival of Wells Hatchery yearling summer chinook by brood.	78
Figure 63. Average percent contribution of Wells Hatchery yearling summer chinook to fisheries and escapement for broods 1986 and 1987.	79
Figure 64. Survival of Wells Hatchery subyearling summer chinook by brood.	80
Figure 65. Average percent contribution of Wells Hatchery summer chinook to fisheries and escapement for broods 1986 and 1987.	81

ABSTRACT

The Bonneville Power Administration (BPA) funds the "Annual Coded Wire Tag Program - Missing Production Groups for Columbia River Hatcheries" project. The Washington Department of Fisheries (WDF), Oregon Department of Fish and Wildlife (ODFW) and the United States Fish and Wildlife Service (USFWS) all operate salmon and steelhead rearing programs in the Columbia River basin. The intent of the funding is to coded-wire tag at least one production group of each species at each Columbia Basin hatchery to provide a holistic assessment of survival and catch distribution over time.

Three main objectives of the WDF portion of the study are to: 1) coded-wire tag at least one production group of each species at each Columbia Basin hatchery to enable evaluation of survival and catch distribution over time, 2) recover coded-wire tags from the snouts of fish tagged under objective 1 and estimate survival and contribution rates to the fisheries for each group, and 3) report findings of coded-wire tag recoveries for all 1986- 1989 broods of chinook, and 1988 and 1989 broods of coho released from WDF Columbia Basin hatcheries.

Objective 1 for FY-93 was met with a few modifications to the original FY-93 proposal. Several groups of fall chinook that were proposed for tagging under this contract were subsequently tagged using funding from various other facility owners. This allowed WDF to tag several production groups at other hatcheries which had been funded by the Pacific Salmon Treaty (PST) program. Funds for these groups were lost due to budget shortfalls in the PST program. Under Objective 2, snouts containing coded-wire tags that were recovered during FY-92 and FY-93 were decoded but survival estimates were not made as all data were not available to do so.

Survival and contribution rates to the various fisheries and escapement were analyzed using coded-wire tag groups from 1986 and 1987 broods of spring, summer, and fall chinook, and 1988 and 1989 brood coho. Coho survivals for 1989 brood releases were lower than 1988 brood releases. Survivals of 1988 brood Type N coho ranged from 1.6-8.4 % and for Type- S coho from 3.0-3.4 %. Survivals of 1989 brood coho were much lower than 1988 brood coho and ranged from 0.2-1 .6 % and 0.1-0.8 %, respectively. Type-N coho contributed primarily to the Washington and Oregon coastal sport and troll fisheries, and the Columbia River gillnet fishery. Type S coho contributed primarily to the Washington and Oregon coastal sport and troll fisheries. Survivals varied according to release location and date of release.

Survivals of 1986 and 1987 brood fall chinook ranged from 0.07-1 .8 %, and 0.04-0.8 %, respectively. Survivals of 1986 and 1987 brood spring chinook ranged from 0.2-2.5 %, and 0.02-1 .8 % , respectively. Survivals of 1986 and 1987 brood summer chinook ranged from 0.004 -0.5 %, and 0.004 -0.2 %, respectively. Differences in survival rates within species varied among stocks and release location. Fall chinook

contributed primarily to the Canadian, Washington coastal, and Columbia River gillnet fisheries; spring chinook to the Canadian and Washington coastal fisheries; and summer chinook to the Canadian and Alaska fisheries. Escapement as a percentage of total survival ranged from 0-56% for fall chinook, 45-96% for spring chinook, and 22-35% for summer chinook.

Data generated by this project contributes to WDF's obligations for representative tagging under the Endangered Species Act (ESA) permit for operating Columbia Basin facilities. WDF facilities operating outside the Snake River basin are required to have a Section 10, "Incidental Take" permit. Consistent with special conditions within this permit, WDF has now reached it's objective to tag representative groups from all WDF Columbia Basin releases.

INTRODUCTION

The Columbia Basin Fish and Wildlife Program Section 203 (a) proposes an interim goal of doubling the runs of salmon and steelhead in the Columbia River basin. Doubling means increasing the current run size of 2.5 million fish to 5.0 million fish. As part of this effort Section 206 (c) states an objective of exploring methods for substantially increasing and improving hatchery production at existing hatcheries. Section 206 (e) (1) states that BPA shall fund collection of Columbia Basin hatchery data for anadromous fish. These data will include at a minimum: number of returning adults; disposition of returning adults; source and description of broodstock; actions to maintain genetic diversity; and size, location and time of release of juvenile fish.

A system of monitoring and evaluation is necessary to measure present and future levels of fish production by various hatchery and natural fish production components. In order to evaluate the success of this program in attaining the goal of doubling the size of fish runs, a continuous long term data set is necessary.

In September 1989 the Washington Department of Fisheries received a contract from the Bonneville Power Administration to begin a project of annually coded-wire tagging missing production groups of anadromous salmonids. Some groups of fish at some hatcheries were already being tagged by other programs, therefore this contract consisted of identifying and tagging a representative number of fish from each production group not currently tagged. This project began with the tagging of juvenile salmon in 1990 (1989 brood fall chinook and 1988 broods of spring and summer chinook, and coho).

The sequential tagging of representative groups of juvenile salmon from each WDF facility allows for long term evaluation of survival and fishery contribution of all release groups among hatcheries. This information is essential for evaluating the effectiveness of hatchery production in the Basin, as well as for determining where improvements in hatchery fish performance need occur. These data also aid in more effective implementation of fisheries management programs, particularly as they relate to listed salmonid stocks.

As salmon mature in the ocean they are harvested in various fisheries, or return to freshwater production areas where they can be enumerated. Each fishery or freshwater spawning area is sampled to recover coded-wire tags. Recovery data from sampling efforts are reported to the Pacific States Marine Fisheries Commission (PSMFC). Release and recovery data as well as sampling rates, and marked to unmarked ratios in the sample are stored in PSMFC computers. These data are then used to estimate survival and contribution rate to each fishery for each hatchery or wild production group. Evaluation of calculated survival and contribution rates are then used as a relative measure of each production groups effectiveness in meeting program goals. In turn this information can be used to direct future efforts in

maintaining or enhancing fish runs in the Columbia Basin as well as providing valuable information to salmon harvest managers.

APPROACH

The goals of this program are to develop a tool with which to estimate hatchery production survival and fishery contribution and evaluate the effectiveness of WDF Columbia River salmon hatcheries in respect to meeting production goals consistent with ESA concerns. Work has progressed under the following three objectives:

Objective 1. Implement the project by coded-wire tagging at least one group of fish representative of each hatchery's production of a given species that is currently not being tagged through another program.

Objective 2. Recover coded-wire tagged fish under objective 1 and decode these tags to estimate survival and contribution of each group released each year, and evaluate results.

Objective 3. Develop preliminary catch and contribution data for all WDF Columbia River hatcheries using 1986-1 989 brood chinook, and 1988 and 1989 brood coho, and prepare an annual report for all WDF Columbia Basin hatcheries.

RESULTS

Objective 1. A total of 1,454,371 fall chinook, 384,653 spring chinook, 229,021 summer chinook, and 405,901 coho were tagged during the contract period (Table 1). Releases of 1992 brood chinook tagged during FY-93 are given in Table 2. Releases of yearling chinook and coho (1991 brood) tagged during FY-92 are given in Table 3.

Numbers of tagged fish increased in FY-93 due to inclusion of several new production groups that were either previously tagged under other programs or were new production groups at a given hatchery added during the fiscal year. These new groups include 225,950 spring chinook sub-yearlings at Klickitat Hatchery destined for off-station plants; 91,130 fall chinook and 30,000 coho at Toutle Hatchery (formerly tagged under NMFS funding); an additional 72,445 fall chinook at Grays River Hatchery (fall release component); an additional 91,601 fall chinook at Elokomin Hatchery (different release time and rearing pond component); an additional 91,005 fall chinook at Lower Kalama Hatchery (previously untagged, and not identified until 1993), an additional 86,004 fall chinook at Washougal Hatchery (new production group). One tag program was discontinued and used to tag two new additional groups. The 225,000 tags scheduled for use on subyearling summer chinook at Wells Hatchery were used instead to tag 75,492 subyearling fall chinook at Rocky Reach Hatchery (new program) and 150,000 subyearling fall chinook at Cowlitz Hatchery (previously tagged under Pacific Salmon Treaty funds).

Table 1. Tagging summary and expenditures during FY-93 for 1991 brood yearling coho and chinook and 1992 brood subyearling chinook. Table includes those production groups tagged under contract with BPA.

HATCHERY	SPECIES	TAG DATE	NUMBER TAGGED	COST (\$)¹
GRAYS	F.CHINOOK	MAY 5.1993	349.684	41.414
GRAYS	TYPE-S COHO	JAN 6.1993	61.649	7.297
ELOKOMIN	F.CHINOOK	MAY 20.1993	163.356	21.703
ELOKOMIN	TYPE-N COHO	JAN 14.1993	30.674	3.631
ELOKOMIN	TYPE-S COHO	JAN 14.1993	30.707	3.634
TOUTLE	F. CHINOOK	MAY 5. 1993	91,103	10.783
TOUTLE	TYPE-S COHO	NOV 3. 1992	30.360	3.590
COWLITZ	F. CHINOOK	MAY 28.1993	150,000	17.755
LOWER KALAMA	F. CHINOOK	MAY 28.1993	91,891	10.877
LOWER KALAMA	SP. CHINOOK	MAY 5. 1992	117,194	13.872
LOWER KALAMA	TYPE-S COHO	DEC 12.1993	31,525	3.728
KALAMA FALLS	F. CHINOOK	MAY 18.1993	96,320	11,401
KALAMA FALLS	TYPE-N COHO	DEC 1.1992	31,335	3.709
WASHOUGAL	F. CHINOOK	JUNE 3.1993	184,108	21,792
WASHOUGAL	TYPE- N COHO ON-STATION	NOV 11.1992	31,832	3.767
WASHOUGAL	TYPE-N COHO KLICK. RIVER	NOV 11.1992	63,814	7,553
KLICKITAT	F. CHINOOK	APR 29.1993	232,217	27,486
KLICKITAT	SP. CHINOOK	APR 13.1993	225,950	26,745
KLICKITAT	TYPE-N COHO	JUL 7, 1992²	47,234	5.591
RINGOLD	SP. CHINOOK	OCT 28.1992	41,509	4,913
ROCKY REACH	F. CHINOOK	MAY 23.1993	75,492	8,936
ROCKY REACH	TYPE-N COHO	JUL 15.1992²	46,771	5.536
WELLS	SU. CHINOOK	MAR 24, 1992²	229,021	27,109
TOTALS			2,473.946	292.822

¹ includes cost of tagging services and 16.5% overhead.

² Fish are tagged prior to the start of the fiscal year due to operational logistics. Billing occurs after the beginning of the fiscal year

Table 2 Releases of 1992 brood subyearling fall chinook tagged during FY-93 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
GRAYS	FALL CHINOOK	5/5/93-10/15/93	337,471	1,360,180
ELOKOMIN	FALL CHINOOK	6/9/93-6/29/93	182,522	4,605,200
TOUTLE	FALL CHINOOK	6/14/93-6/18/93	88,952	2,903,000
COWLITZ	FALL CHINOOK	6/3/93-6/22/93	194,073 ³	4,403,000
KALAMA FALLS	FALL CHINOOK	6/1/93-6/21/93	91,519	3,543,700
LOWER KALAMA	FALL CHINOOK	6/16/93	91,005	2,041,800 ⁴
WASHOUGAL	FALL CHINOOK	6/17/93-8/3/93	178,415	6,226,200
KLICKITAT	FALL CHINOOK	5/21/93-6/16/93	224,393	4,152,000
ROCKY REACH	FALL CHINOOK	5/5/93	57,477	1,217,601
TOTALS			1,445,827	30,452,681

³ 150,000 of this total was tagged under this projects funds.

⁴ 1,003,700 were released from Gobar Pond, located upstream of the hatchery

Table 3. Releases of 1991 and 1992 brood spring and summer chinook tagged during FY-93 under contact with BPA.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
LOWER KALAMA	SP.CHINOOK	4/5/93	103,105	525,800
KLICKITAT	SP. CHINOOK SUBYEARLINGS	6/10/93	221,872	305,400
RINGOLD	SP. CHINOOK	4/1/93	44,557	669,400
WELLS	SU. CHINOOK	4/16/93	123,585	392,300
TOTALS			493,119	1,892,900

Table 4. Releases of 1991 brood coho tagged during FY-93 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
GRAYS	TYPE-S COHO	4/9/93	60,291	364,000
ELOKOMIN	TYPE-S COHO	4/2/93	29,318	610,500
ELOKOMIN	TYPE-N COHO	4/1/93-4/17/93	29,877	1,294,700
TOUTLE	TYPE-S COHO	4/13/93	29,394	1,057,200
KALAMA FALLS	TYPE-N COHO	4/21/93	29,999	975,800
LOWER KALAMA	TYPE-S COHO	4/28/93	31,171	553,900
WASHOUGAL	TYPE-N COHO ON-STATION	4/12/93-4/28/93	31,136	517,900
WASHOUGAL	TYPE-N COHO KLICKITAT R.	4/5/93	56,850	2,500,000
KLICKITAT	TYPE-N COHO	5/31/93	39,143	1,360,000
ROCKY REACH	TYPE-N COHO	5/5/93	44,594	201,000
TOTALS			381,773	9,435,000

Table 5. Releases of 1991 brood yearling chinook and coho and 1992 brood subyearling chinook during PY-93. This table represents groups tagged under other (non-BPA) funding sources.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
COWLITZ	SP. CHINOOK	APR 5, 1993	375,115	1,571,187
COWLITZ	TYPE-N COHO	APR-JUN, 1993	71,475	4,610,600
LEWIS RIVER	SP. CHINOOK	FEB-MAR, 993	126,319	1,510,400
LEWIS RIVER	TYPE-N COHO	APR-JUN, 1993	62,037	5,428,200
LEWIS RIVER	TYPE-S COHO	APR-MAY, 1993	71,649	956,900
LYONS FERRY	FALL CHINOOK	APR 12-19 '93	749,863	760,018 ^s
LYONS FERRY	FALL CHINOOK	JUN 24, 1993	203,177	206,775
TUCANNON	SP. CHINOOK	APR 12, 1993	72,455	74,058 ^s
TUCANNON	SP. CHINOOK	OCT 21, 1993	56,736	57,316 ^s
PRIEST RAPIDS	FALL CHINOOK	MAY-JUN, 1993	931,806	7,134,159
ROCK ISLAND	SP. CHINOOK	APR 28, 1993	19,677	20,002
ROCK ISLAND	SU. CHINOOK	MAY 25, 1993	95,624	191,179
ROCK ISLAND	SOCKEYE	SEP-OCT, 1993	243,202	340,557
METHOW	SP. CHINOOK	APR 15, 1993	0	22,259
METHOW	SU. CHINOOK	MAY 12, 1993	377,097	540,900
SIMILKAMEEN	SU. CHINOOK	APR 9, 1993	360,380	675,500
TOTALS			3,816,612	24,100,010

^s Groups were tagged at the 100% level. Discrepancy between tagged release and total release, are the AD only fish.

Objective 2. A total of 3,148 tags were recovered from Columbia River fall, spring, and summer chinook, and coho during FY-93. Recoveries at hatcheries from March-September, 1993 are not included in the above total. Because catch data for broods tagged under this project are not yet finalized no reporting of findings will occur for FY-93.

Objective 3. Summaries of coded wire tag information for groups of 1986 and 1987 brood chinook and 1988 and 1989 brood coho are listed by hatchery. For descriptions of individual hatcheries the reader is referred to "Operations Plans for Anadromous Fish Production Facilities in the Columbia River Basin: Volume IV"⁶

Grays River Hatchery- Grays River Hatchery rears and releases Tule fall chinook and Type-S (early) coho. Fall chinook survivals have ranged from 0.1% to over 8.0% depending on brood and release type (Figure 1). Releases of 4-5g fish in June generally result in survivals under 1.0%. Fish released in the fall months (> 20 g) generally survive at over 1.0%. A group of large sized (> 12 g) 1985 brood fish released in May survived at over 1%. Fall chinook of the 1986 or 1987 brood were not tagged and data from broods tagged under this project are not yet available. Recent contribution data are also unavailable.

Coho survivals have ranged from 0.1-3.4% depending on brood and release type (Figure 2). In recent years one group of coho has been released in April and the other in May. Data from these releases are pending. 1988 and 1989 Grays River Type-S coho contributed primarily to the Oregon sport and troll fisheries, the Washington coastal sport fishery, and the Columbia River gillnet fishery. Escapement amounts to about 17% of the total survival (Figure 3).

Elokomin River Hatchery- Elokomin Hatchery rears and releases Tule fall chinook, and both Type-N and Type-S coho. Fall chinook survivals have ranged from 0.01%-0.52% depending on brood (Figure 4). Most tag groups represent fish released in June at sizes ranging from 4.5-6.0 g. A group of large fall chinook (> 12 g; 1985 brood) juveniles released in the spring survived at nearly 1%. No fish from the 1986 or 1987 broods were tagged. The 1988 brood was used in a release timing study along with fish at Kalama Falls Hatchery. Data from broods tagged under the current project are not yet available. Recent contribution data are also unavailable.

Type-N survivals have ranged from 0.3-7.8% (Figure 5). 1988 and 1989 brood Type-N coho contributed primarily to the Oregon fisheries, the Columbia River gillnet fishery, and to the Washington coastal sport fisheries (Figure 6). Elokomin Type-S coho survivals have ranged from 0.2-3.3% (Figure 7). Only three broods have been tagged. 1988 and 1989 brood Type-S coho contributed primarily to the Oregon sport

⁶ 1992 Annual Report. U.S. Department of Energy, Bonneville Power Administration. Division of Fish and Wildlife.

and troll, and Washington coastal sport fisheries (Figure 8).

Cowlitz River Hatchery- Cowlitz Hatchery rears and releases fall chinook, spring chinook, and Type-N coho. Survivals of fall chinook have ranged from 0.04-1.73% depending on brood (Figure 9). Most tag groups represent fish released in June at sizes ranging from 5.0-6.5 g, however there have been some releases of large juvenile fish in the fall months. Survivals of 1986 and 1987 brood fall chinook were 0.20% and 0.04%, respectively. The majority of the survival of these two broods (Figure 10) was to escapement (54.1%), but moderate catches were made by Washington coastal sport and troll fishers as well as Canadian fishers (Figure 10).

Cowlitz spring chinook survival ranged from 0.8-10.3%, depending on brood (Figure 11). Most tag groups represent fish released as yearlings (45-60 g) in either March, April, or May. Survivals of 1986 and 1987 brood fish were 2.7% and 1.8%, respectively. The majority of the survival is to escapement (45.1%; figure 12), but moderate catches are made by Washington coastal sport and troll fishers as well as Canadian fishers.

Survivals of Cowlitz Type-N coho have ranged from 0.9-6.9%, depending on brood (Figure 13). Oregon and Washington fishers accounted for most of the catch of the 1988 and 1989 brood fish. The Columbia River gillnet accounted for about 11% of the total survival (Figure 14).

Toutle River Hatchery- Toutle Hatchery rears and releases Tule fall chinook and Type-S coho. The hatchery reared fish until the eruption of Mt. Saint Helens in May, 1980. The hatchery was partially restored to operation in 1987. Survivals of 1971-1977 brood fall chinook ranged from 0.3-0.9% (Figure 15). The survival of the 1987 brood fall chinook was 0.02%. Chinook released at Toutle hatchery range in size from 4.5-5.5 g, and are released primarily in June. The majority of the 1987 brood fish were caught by Canadian fishers (50%; figure 16), although moderate catches were made by Washington coastal sport and troll fishers.

Toutle Type-S coho survivals have ranged from 0.5-5.9% depending on brood and release type (Figure 17). Oregon fishers caught the majority of the 1989 brood fish. Escapement of the 1989 brood was over 30% of the total survival (Figure 18).

Lower Kalama Hatchery- Lower Kalama Hatchery rears and releases Tule fall chinook, spring chinook, and Type-N or Type-S coho. Fall chinook are typically reared until June and released at 4.5-5.5 g. Tag data for this hatchery are limited (Figure 19). Survivals have ranged from 0.06-1.0%. This hatchery was only recently included in this project (1991 brood) and therefore no current survival or contribution data are available.

Spring chinook are normally reared until late-March or April and released at sizes ranging from 45-55 g. These fish were included in the project beginning with the

1989 brood and therefore current tag data are unavailable for this stock. It will be several years before survivals and contribution rates will be known. Past releases were made from Kalama Falls Hatchery (Figure 24).

Tag groups of Type-N coho were released from the hatchery from the 1980 and 1981 broods and survived at 2.7% in each brood (Figure 20). Only two broods of Type-S coho have been released from Lower Kalama Hatchery. Survivals for the 1988 and 1989 broods were 5.5% and 0.2%, respectively (Figure 21). Oregon and Washington coastal sport fishers harvested the largest proportion of these fish. Columbia River gillnet fishers caught about 7% of these fish, and about 23% of the total survival was to escapement (Figure 22).

Kalama Falls Hatchery- Kalama Falls Hatchery rears and releases fall chinook, and either Type-S or Type-N coho. Fall chinook (1971-1981 broods) survivals have ranged from 0.1-1.4% (Figure 23). The most recent brood that was tagged is the 1988 brood which was part of a release timing study. Data from this study are preliminary and not reported here. Fall chinook are reared to 4.5-5.5 g and released in late-May to July.

Type-N coho survivals have ranged from 0.7-8.4% depending on brood (Figure 25). No tagged releases of this stock occurred prior to 1983. Oregon and Washington sport fishers caught nearly equal percentages of these fish, but Columbia River gillnetters caught a much higher proportion of these fish. Escapement accounted for about 9.5% of the total survival (Figure 26).

Lewis River Hatchery- Lewis River Hatchery rears and releases spring chinook and both Type-N and Type-S coho. The hatchery does not rear fall chinook. The Lewis River supports a viable self-sustaining population of naturally reproducing fall chinook. Survivals of these wild chinook range from 0.13-1.89% (Figure 27). The majority of the survival of the 1986 and 1987 broods was to escapement (56.4%) and to the Canadian, Washington coastal sport (including river sport), and Columbia River gillnet fisheries (Figure 28).

Lewis River spring chinook have not been tagged until recent broods and therefore no data are reportable. Funding for this tagging is provided by Pacific Power and Light Company.

Only three broods of Type-N coho have been tagged at Lewis River Hatchery. Survivals have ranged from 1.6-9.2% (Figure 29). The majority of the total catch of the 1988 and 1989 broods was by the Washington coastal sport fishery, Columbia River gillnet fishery, and the Oregon sport fisheries. Escapement was about 21% of the total survival (Figure 30). Survivals of Type-S coho have ranged from 0.2-6.6% depending on brood (Figure 31). The majority of the survival of the 1988 and 1989 broods was to the Oregon and Washington coastal fisheries. Escapement accounted for about 22% of the total survival (Figure 32).

Speelyai Hatchery- Speelyai Hatchery rears both coho and spring chinook, but transfers most of these fish to Lewis River. The only releases directly from the hatchery are into Merwin Lake (coho) to support a resident coho sport fishery.

Washougal River Hatchery- Washougal Hatchery rears and releases Tule fall chinook and Type-N coho. Type-S coho have been reared at the hatchery in the past. The hatchery also provides Type-N coho for off-station plants into the Klickitat Riv . as part of mitigation for the U.S v. Oregon court decision.

Fall chinook survivals have ranged from 0.1-5.0%, depending on brood and release type (Figure 33). Generally higher survivals have been obtained from large sized fish (> 15 g) released in the early fall. Most of the chinook production is released in June at sizes ranging from 4.5-6.0 g. The majority of the survival for the 1986 and 1987 brood fall chinook has been to the Canadian fisheries and escapement. Washington coastal sport and troll fisheries account for about 13% and 6%, respectively, of the total survival (Figure 34).

Survivals of Type-N coho have ranged from 0.5-5.2%, depending on brood and release type (Figure 35). Survivals of 1988 and 1989 brood coho were remarkably similar and did not show the drastic decline in survivals between the 1988 and 1989 broods seen at other hatcheries. Most of the catch has been by Oregon fishers and Washington coastal sport fishers. Escapement and Columbia River gillnet catches have accounted for about 15% and 8%, respectively, of the total survival of these two broods (Figure 36). Survivals of Type-S coho have ranged from 0.4-6.9%, depending on brood (Figure 37). The 1984 brood was the last brood of Type-S coho to be reared at this facility.

Off-station releases of Type-N coho into the Klickitat River survived more poorly than those released on-station. Survival of the 1988 and 1989 broods was 1.6% and 0.2%, respectively (Figure 38). The majority of the survival was to the Oregon fisheries, Washington coastal sport fishery, and the Columbia River gillnet fishery. Escapement of these fish has been about 6.0% for the two broods combined (Figure 39).

Klickitat River Hatchery- Klickitat Hatchery currently rears Upriver Bright chinook that are imported as eggs from Lyons Ferry Hatchery. Prior to introducing this stock at Klickitat, the hatchery reared and released imported Tule fall chinook. The hatchery also rears and releases spring chinook and Type-N coho. Type-S coho have been reared previously. The spring chinook have been tagged in recent years as part of a BPA funded experiment to determine the effects of acclimation to river water prior to release. These data will not be available for several years. Survivals of fall chinook have ranged from 0.05%-1 %, depending on brood (Figure 40). Survival of 1986 brood chinook was 0.3%. The majority of the catch was in the Columbia River gillnet fishery and the various Canadian fisheries (Figure 41). No tags were recovered at the

hatchery

Survivals of spring chinook released from the 1973 and 1975-77 broods are shown in figure 42.

Survivals of Type-N coho have ranged from 0.6-4.5%, depending on brood and release type (Figure 43) . Washington and Oregon coastal sport fishers, and Columbia River gillnetters have caught the highest percentages of the 1988 and 1989 brood fish (Figure 44). There have been no returns of tagged fish to the hatchery.

Survivals of 1972-1983 brood Type-S coho ranged from 1.6-4.5% (Figure).

Lyons Ferry Hatchery- Lyons Ferry Hatchery rears and releases Snake River fall chinook. In recent years 100% of the releases have been marked or tagged to ensure the genetic purity of this stock. The hatchery generally releases four groups of fall chinook, both yearlings or subyearlings, which are released both on-station and loaded on barges to by-pass several dams. Survivals of sub-yearling fish (range: 0.02-0.6%, figure 45) have been much lower than survivals of yearling fish (0.3-7.3%; figure 49). Survivals of barged fish, regardless of age, have been equal to or greater than survivals of fish released on-station (figures 47 and 51). Contribution of subyearling fish has been primarily to Columbia River gillnetters, Canadian commercial fishers, and escapement. Escapement of tagged fish released from barges appears to be slightly higher than those released on station, perhaps because the latter group had higher contribution to the in-river net fishery (figures 46 and 48). Contribution of yearling fish has been mainly to Canadian, Columbia River gillnet, and Washington coastal troll fisheries. Escapement amounted to approximately 21.3% of the survival, however the estimated escapement reported here is an underestimate because expanded data from trapping operations at the dams was not available. Contribution rates to various fisheries did not appear to differ among barged or on-station releases (figures 50 and 52).

Tucannon River Hatchery- The Tucannon Hatchery is a satellite rearing and capture location operating in conjunction with the Lyons Ferry Hatchery. Wild spring chinook returning to the Tucannon River were captured and a portion of the run was used to supply the hatchery releases. Captured adults are now transported to the Lyons Ferry Hatchery and spawned there. This change in procedure has resulted in lower adult holding and egg to fry mortalities. After rearing to approximately 18 g at the Lyons Ferry Hatchery, these fish are transported to an acclimation pond at the Tucannon Hatchery, where they are reared through the winter and volitionally released in the spring. Survivals of these yearling plants have ranged from 0.02-0.3% (Figure 53). Nearly 96% of the total survival of the 1986 and 1987 broods was to escapement. A few fish have been captured in Oregon, Canadian, and Washington fisheries (Figure 54). No tag recoveries from these broods were found in the Columbia river gillnet fishery.

Ringold Springs Hatchery- Ringold springs hatchery rears spring chinook and in the past has reared a few groups of upriver bright fall chinook. The fish are released as yearlings ranging in size between 45-115 g. Broods after 1978 and prior to 1989 were not tagged. Data from these more recent broods is unavailable. Survivals of spring chinook (broods 1975-77) ranged from 1.5-2.6% (Figure 55).

Priest Rapids Hatchery- Priest Rapids Hatchery rears and releases Upriver Bright chinook. Most fish are released in June as subyearlings ranging in size from 5-9 g. Survivals have ranged from 0.03-2.0% depending on brood (Figure 56). Contribution of the 1986 and 1987 broods was primarily to the Columbia River gillnet fisheries, and the Canadian fisheries. Escapement accounted for approximately 30% of the total survival (Figure 57).

Rocky Reach Hatchery- Rocky Reach Hatchery rears fall chinook and coho, although the coho program was discontinued after 1993 and replaced with a subyearling fall chinook program. Rocky Reach rears and releases both yearling and subyearling fall chinook. The yearling fish are released at 41-50 g in April or May. Survivals of the yearling fish have ranged from 0.07-3.6% (Figure 58). The 1986 brood survival was 0.07%. Contribution was primarily to the Canadian and Columbia River gillnet fisheries, with significant catches made by other Oregon and Washington fishers. Escapement was approximately 9.0% of the total survival (Figure 59).

Rocky reach coho have been tagged in only two broods. Survivals have ranged from 0.2-0.9%. The survival of the 1989 brood release was 0.2% (Figure 60). The majority of the survival was to the Oregon sport fishery, the Canadian troll, and the Columbia River gillnet fishery (Figure 61).

Wells Dam Hatchery- Wells Dam Hatchery rears and releases yearling and subyearling summer chinook. Yearling summer chinook are released at sizes ranging from 30-45 g in mid-April. Survivals of yearling releases have ranged from 0.14-0.94% (Figure 62). Contribution of the 1986 and 1987 broods was primarily to Canadian fisheries and to escapement. Contribution to Alaska, Columbia River gillnet and Washington troll fisheries was nearly equal, ranging from 7.5-9.7% (Figure 63). Survival of subyearling releases was much lower than for yearling fish, ranging from 0.004-0.20% (Figure 64). Contribution of subyearling fish was primarily to Canadian fishers and to escapement (Figure 65).

Grays River Hatchery Fall Chinook Subyearlings only

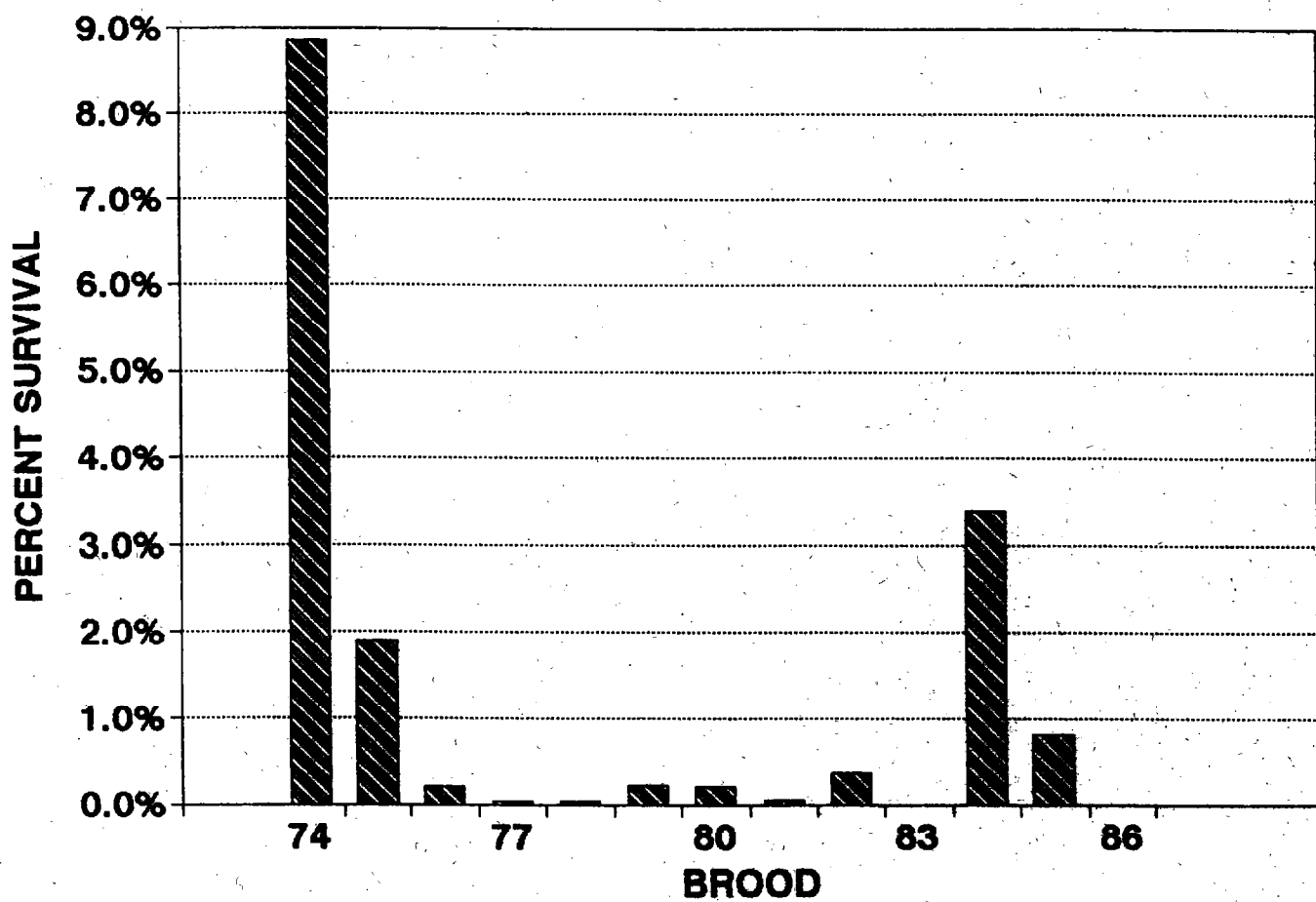


Figure 1. Survival of Grays River tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Grays River Hatchery Coho

Type-S Coho

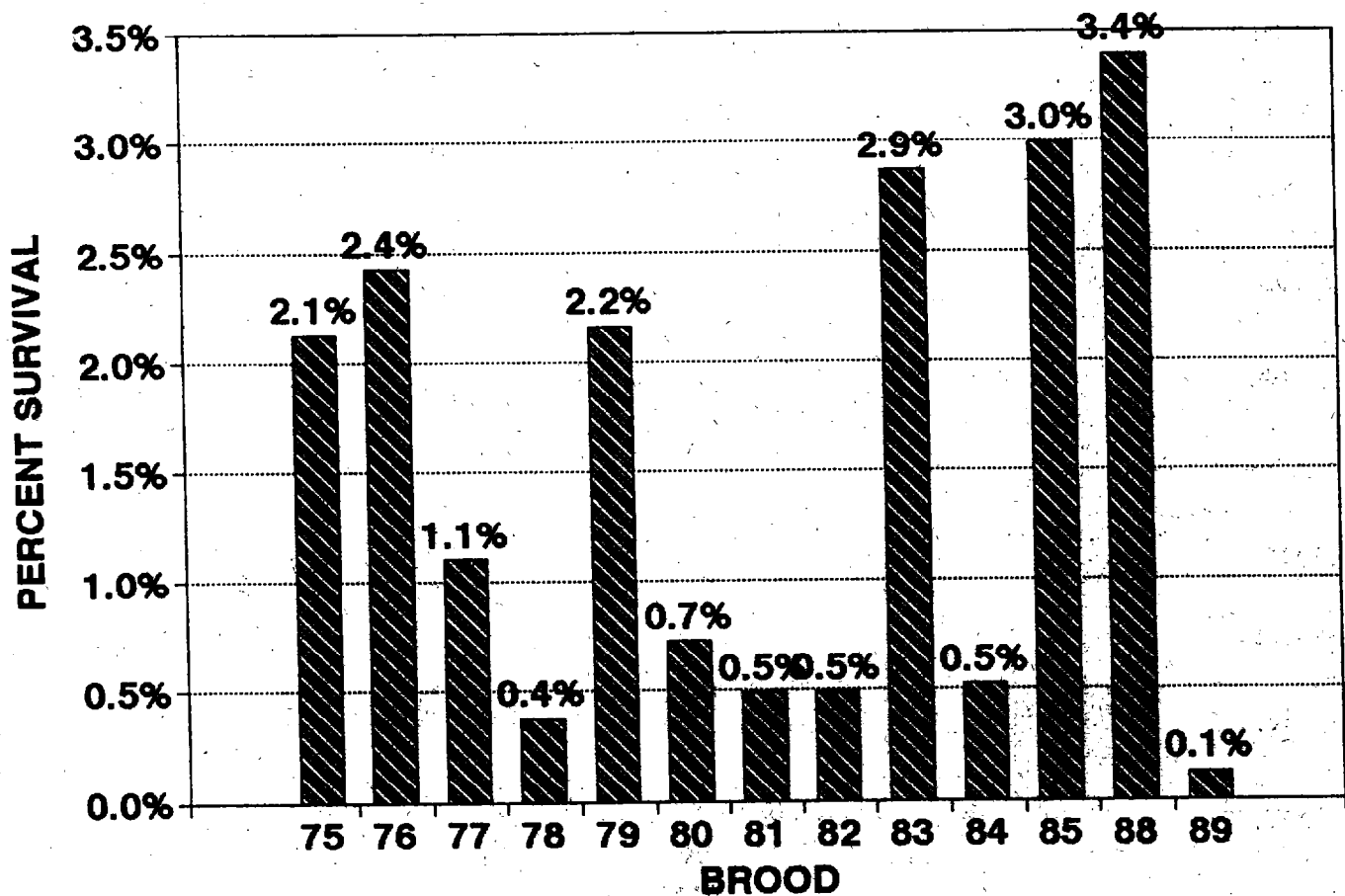


Figure 2. Survival of Grays River Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Grays River Hatchery Coho

1988 & 1989 Brood, Type-S Coho

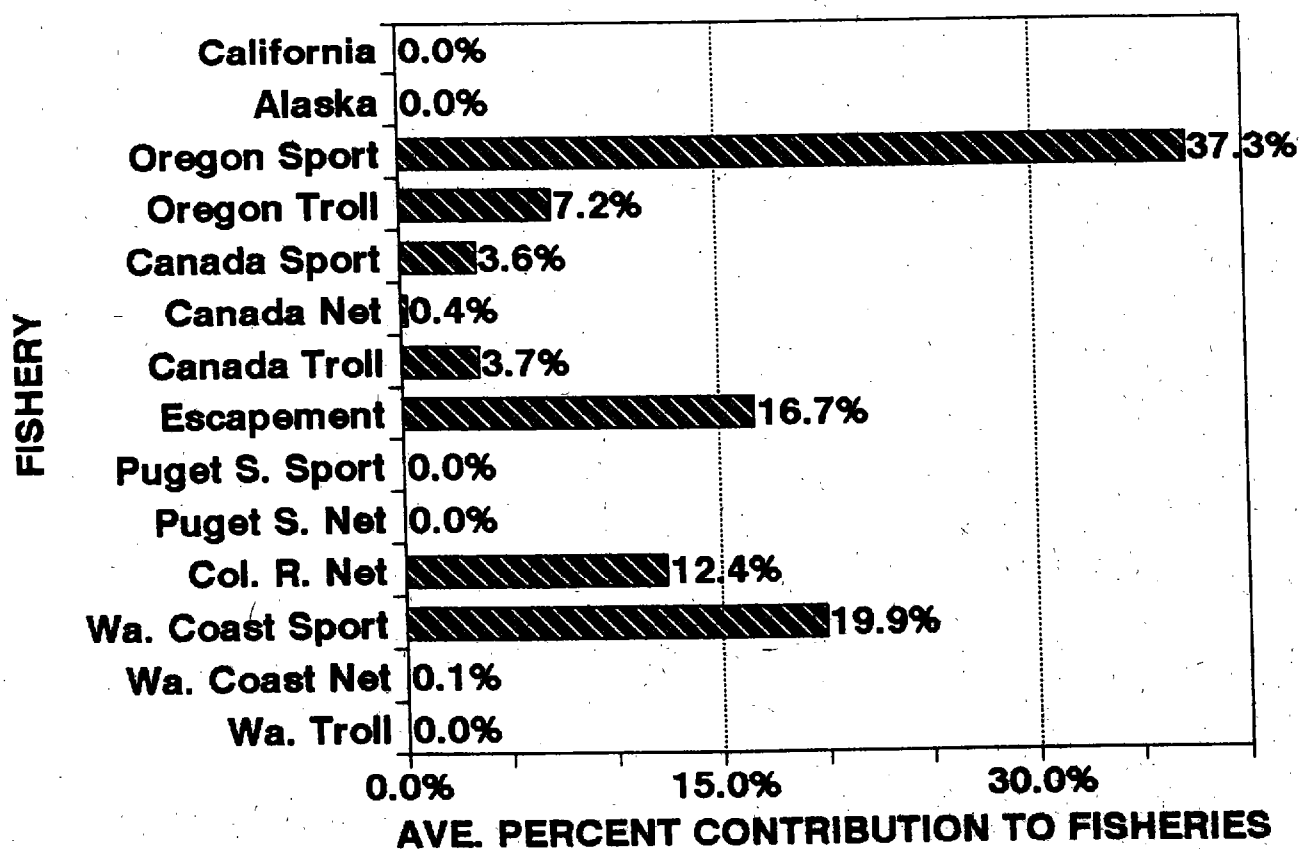


Figure 3. Average percent contribution of Grays River Type-S coho to fisheries and escapement for broods 1988 and 1989.

Elokomin Hatchery Fall Chinook Subyearlings only

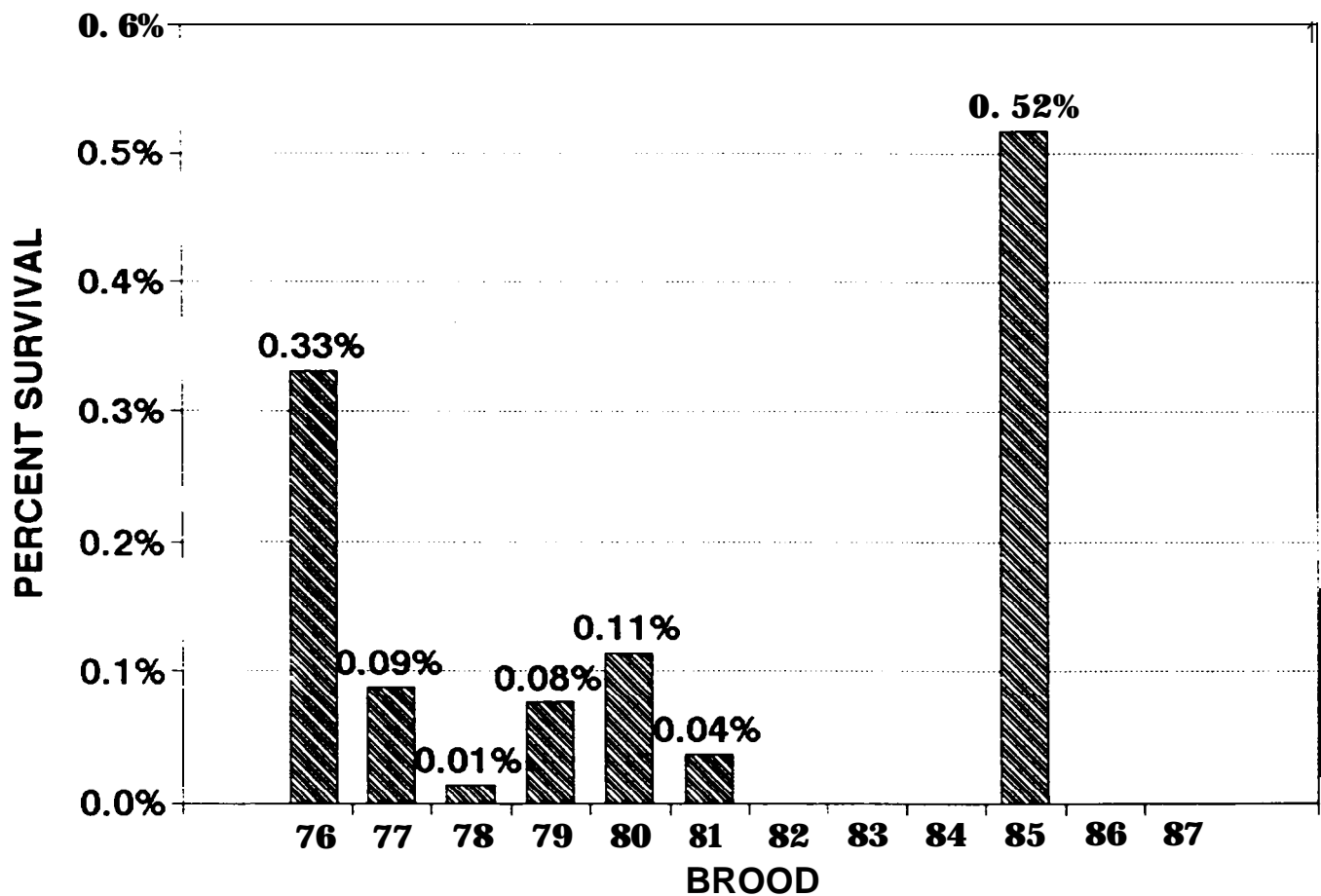


Figure 4. Survival of Elokomin tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Elokomin Hatchery Coho

Type-N Coho

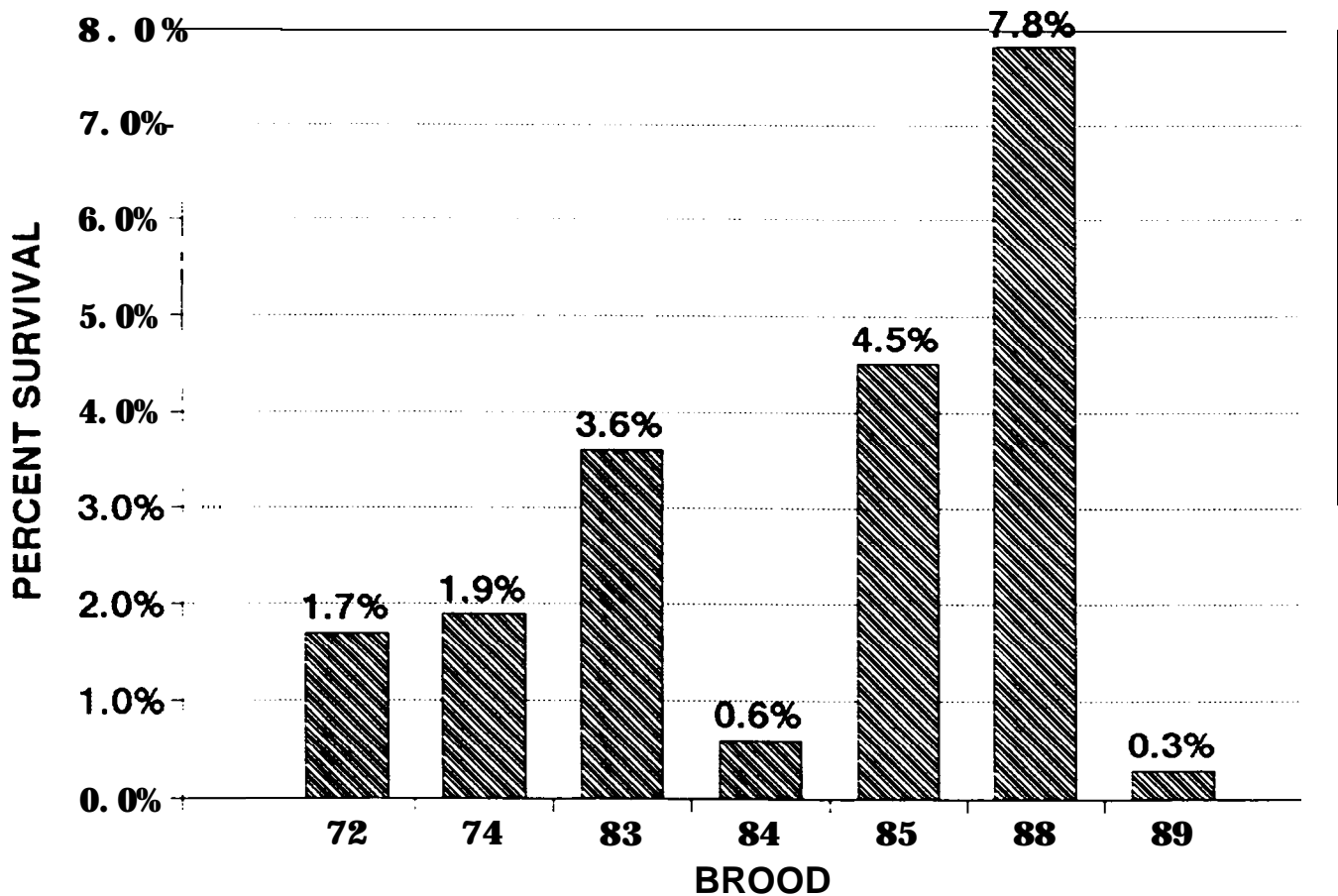


Figure 5. Survival of Elokomin Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Elokomin Hatchery Coho Type-N Coho

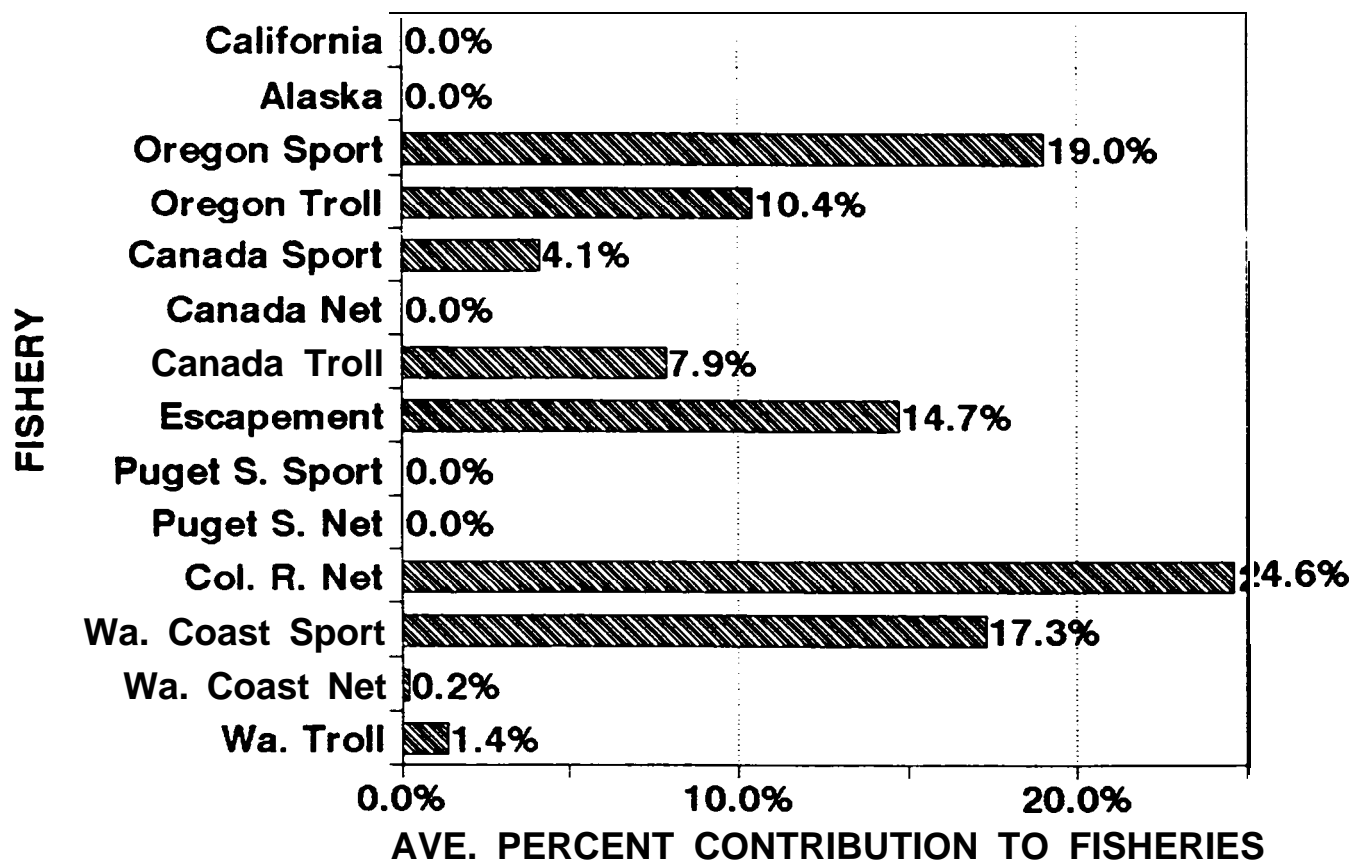


Figure 6. Average percent contribution of Elokomin Type-N coho to fisheries and escapement for broods 1988 and 1989.

Elokomin Hatchery Coho

Type-S Coho

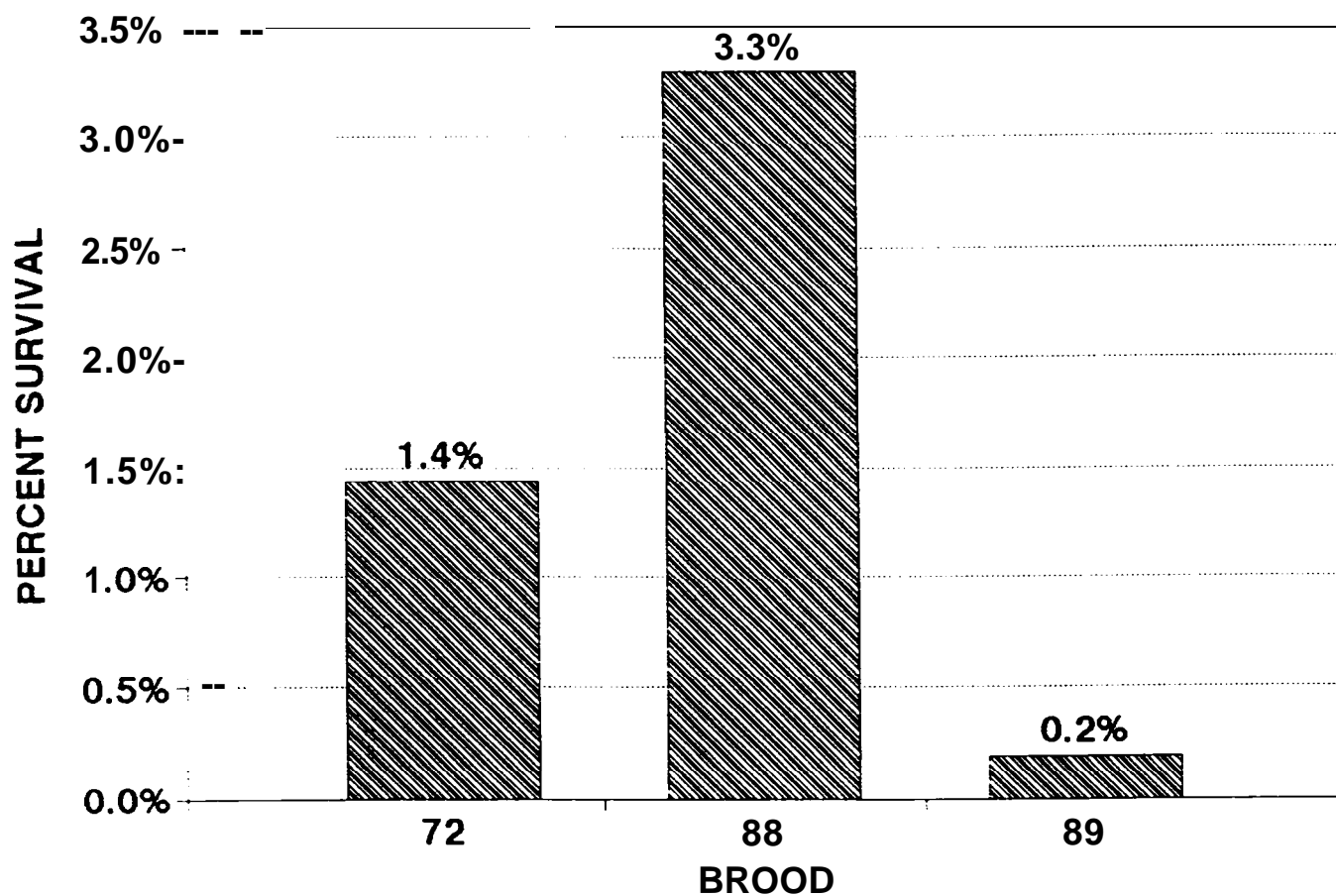


Figure 7. Survival of Elokomin Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Elokomin Hatchery Coho Type-S Coho

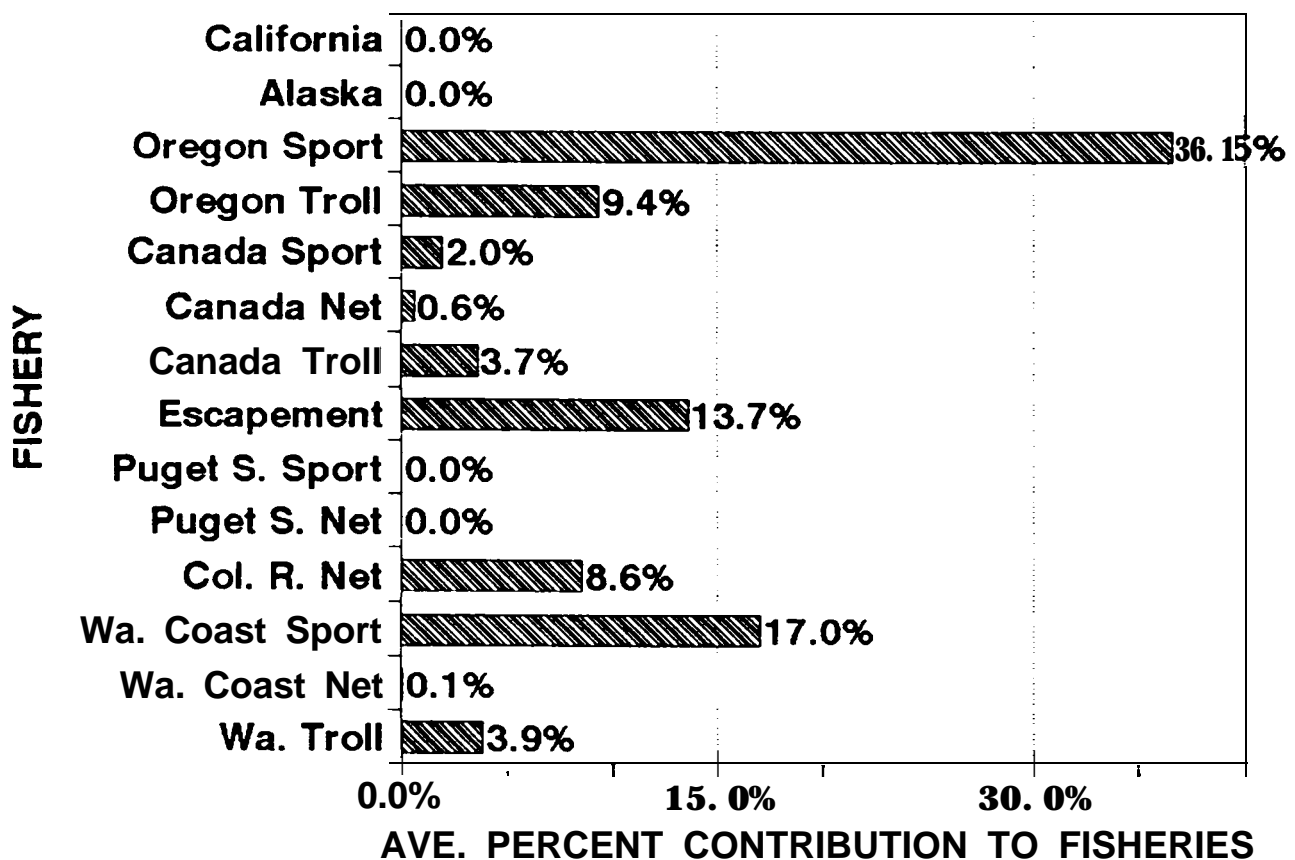


Figure 8. Average percent contribution of Elokomin Type-S coho to fisheries and escapement for broods 1988 and 1989.

Cowlitz Hatchery Fall Chinook Subyearlings only

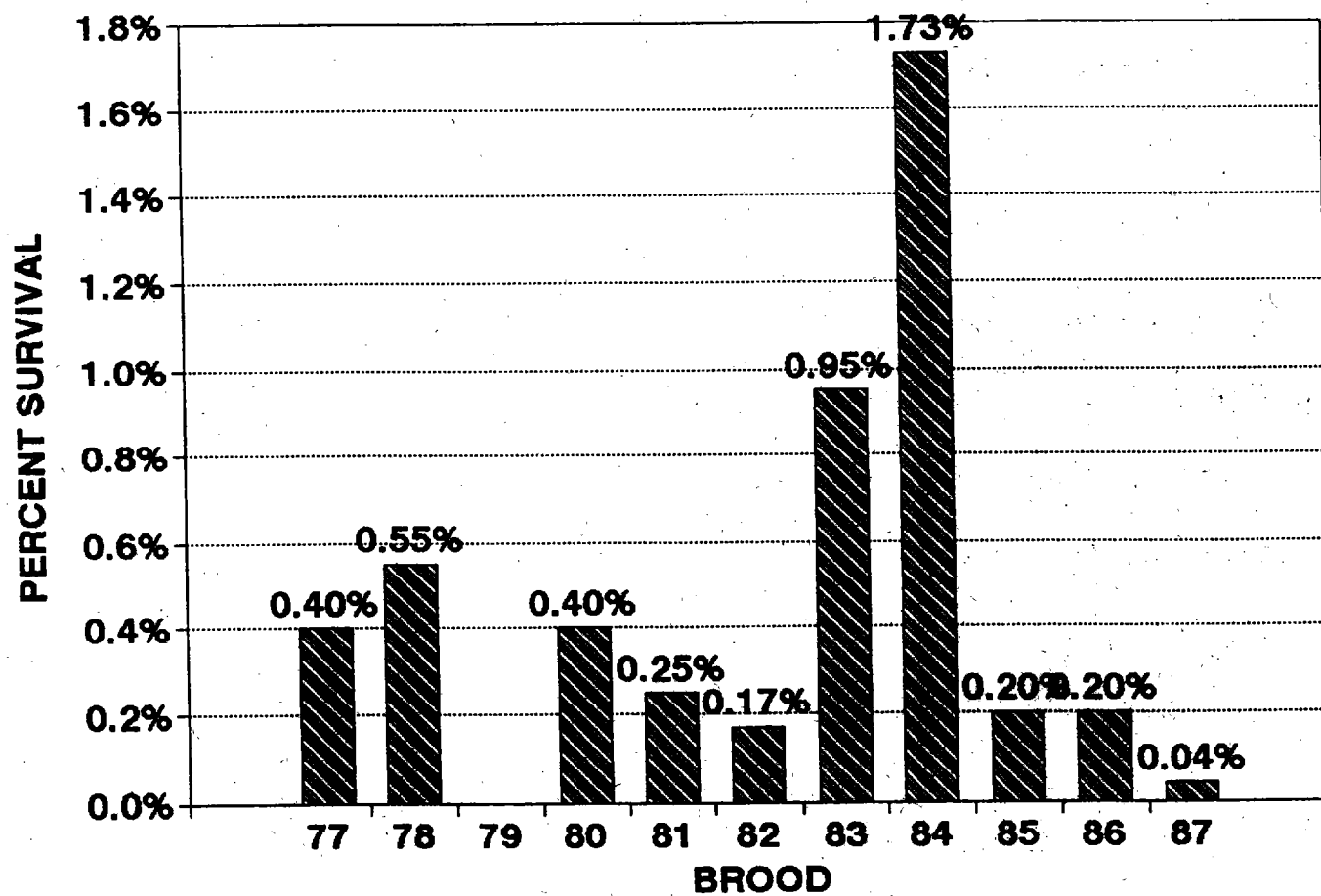


Figure 9. Survival of Cowlitz tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Cowlitz Hatchery Fall Chinook

Subyearlings only, 1986 & 1987 Broods

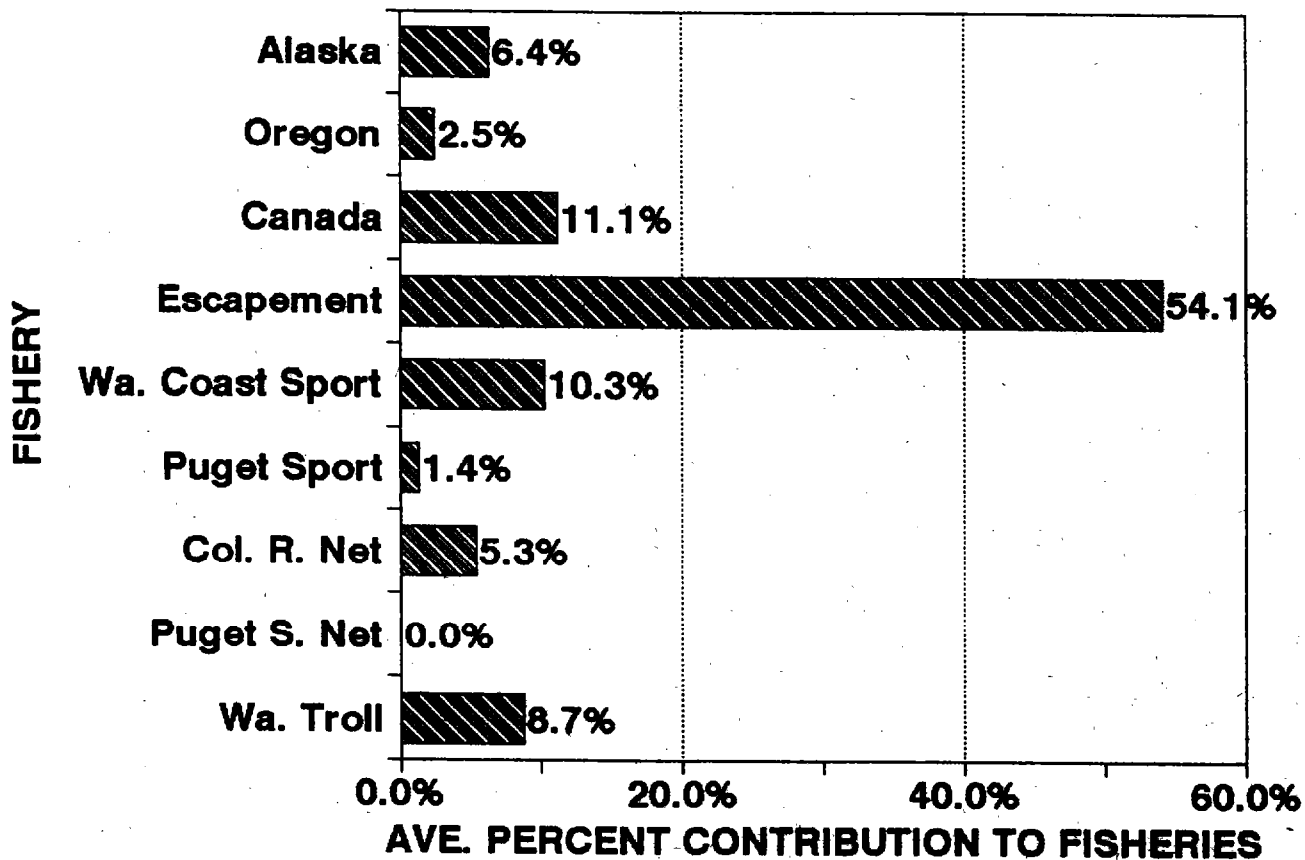


Figure 10. Average percent contribution of Cowlitz tule fall chinook to fisheries and escapement for broods 1986 and 1987.

Cowlitz Hatchery Spring Chinook Yearling Releases

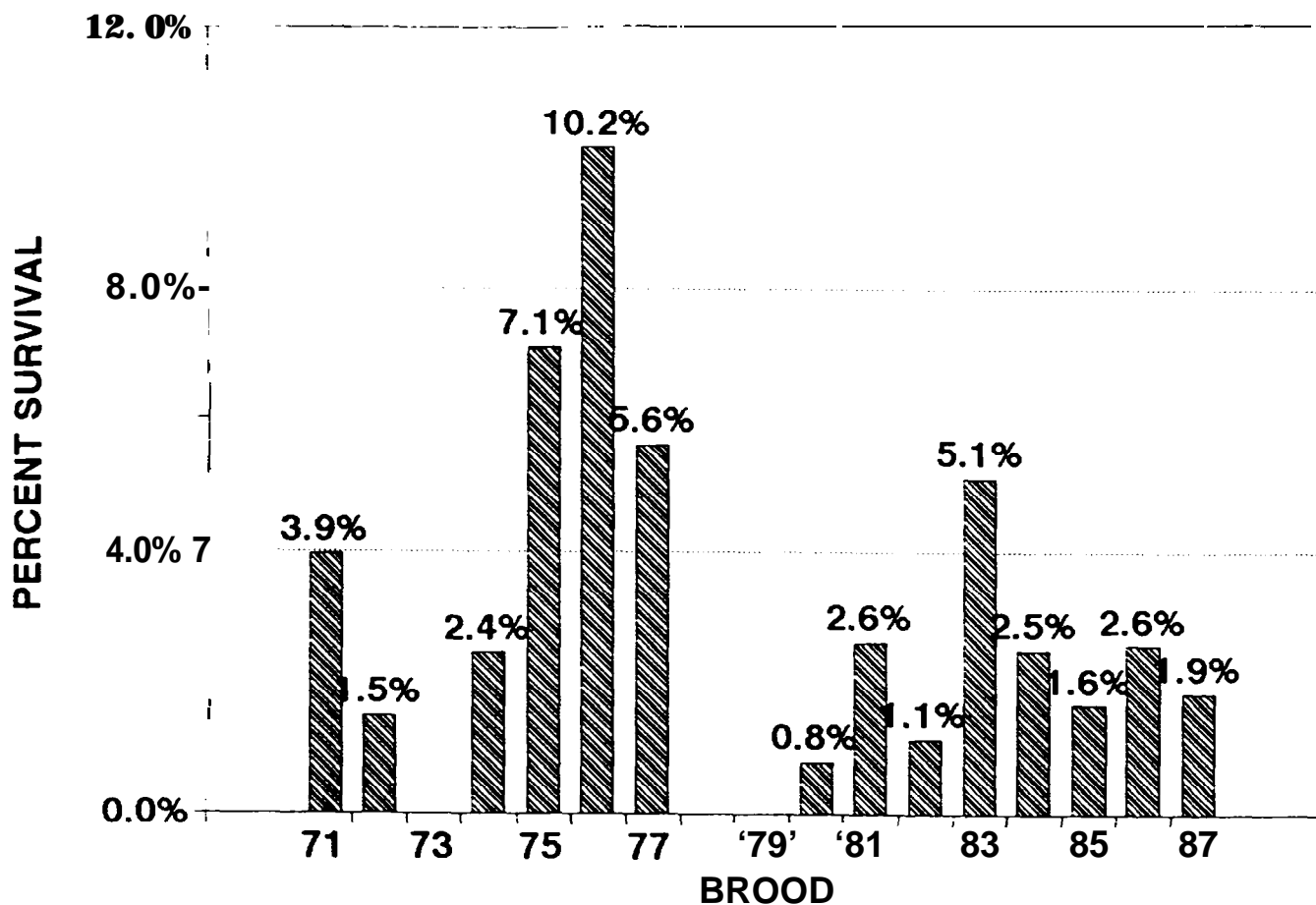


Figure 11. Survival of Cowlitz spring chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Cowlitz Hatchery Spring Chinook 1986 & 1987 Broods

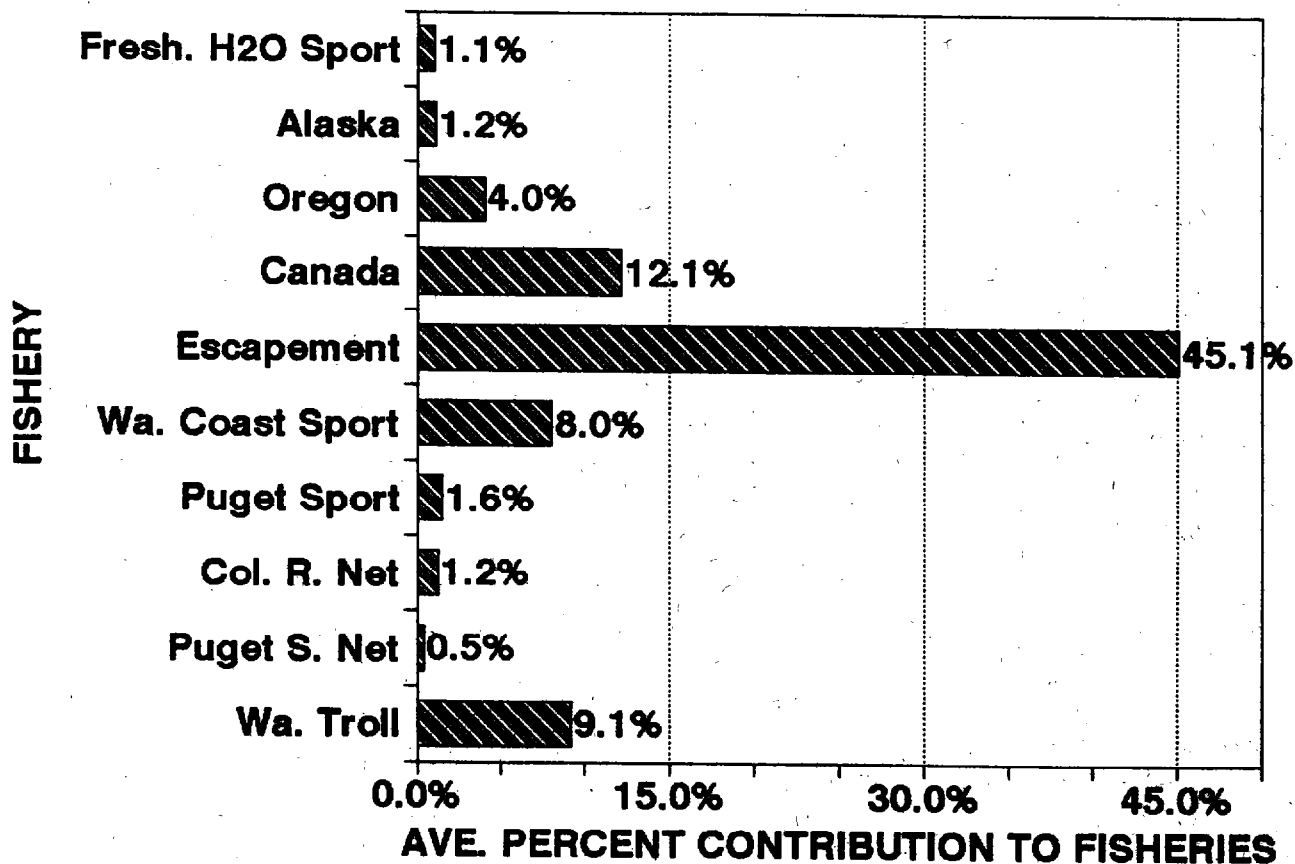


Figure 12. Average percent contribution of Cowlitz spring chinook to fisheries and escapement for broods 1986 and 1987.

Cowlitz Hatchery Coho

Type-N Coho

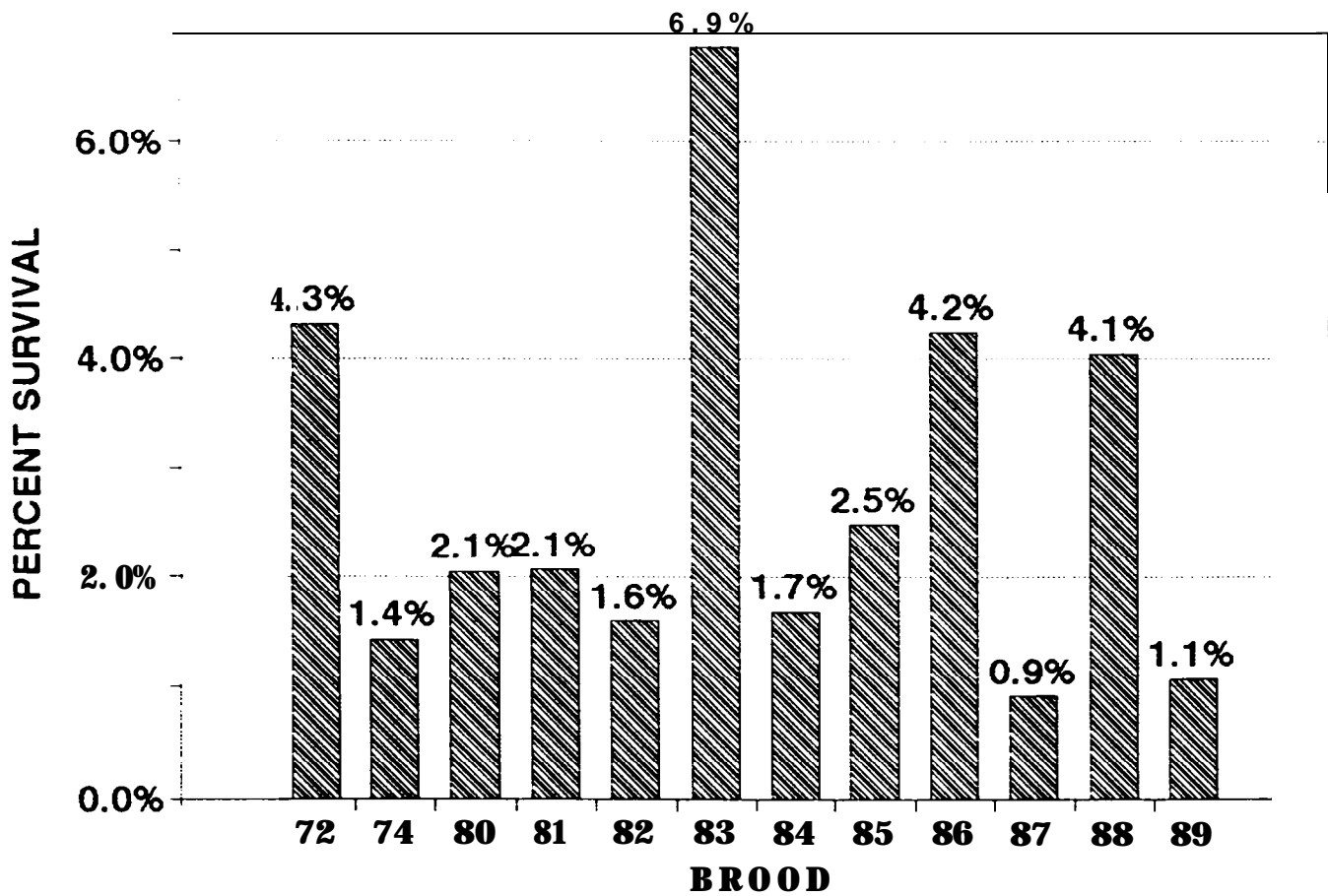


Figure 13. Survival of Cowlitz Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Cowlitz Hatchery Coho

Type-N Coho, 1988 & 1989 Broods

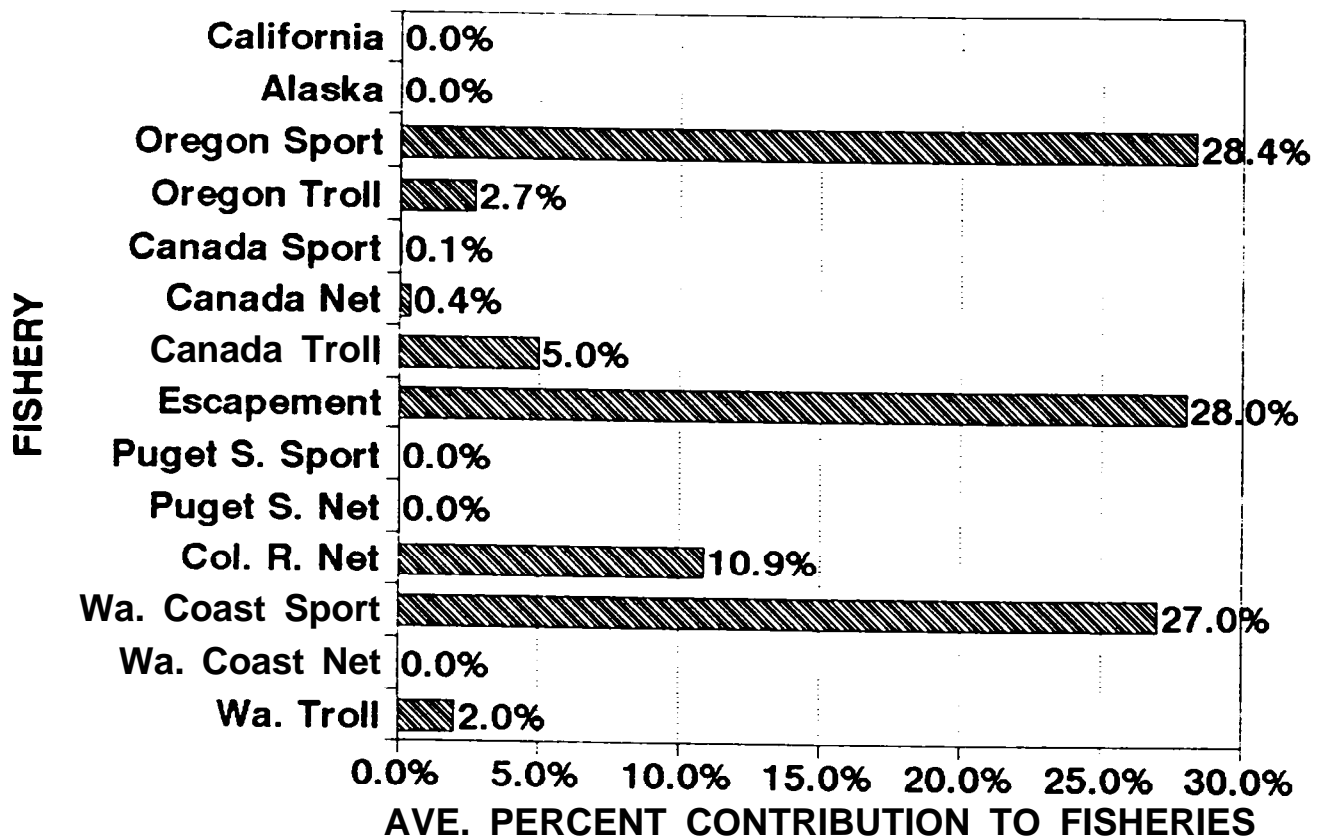


Figure 14. Average percent contribution of Cowlitz Type-N coho to fisheries and escapement for broods 1988 and 1989.

Toutle River Hatchery Fall Chinook

Subyearlings only

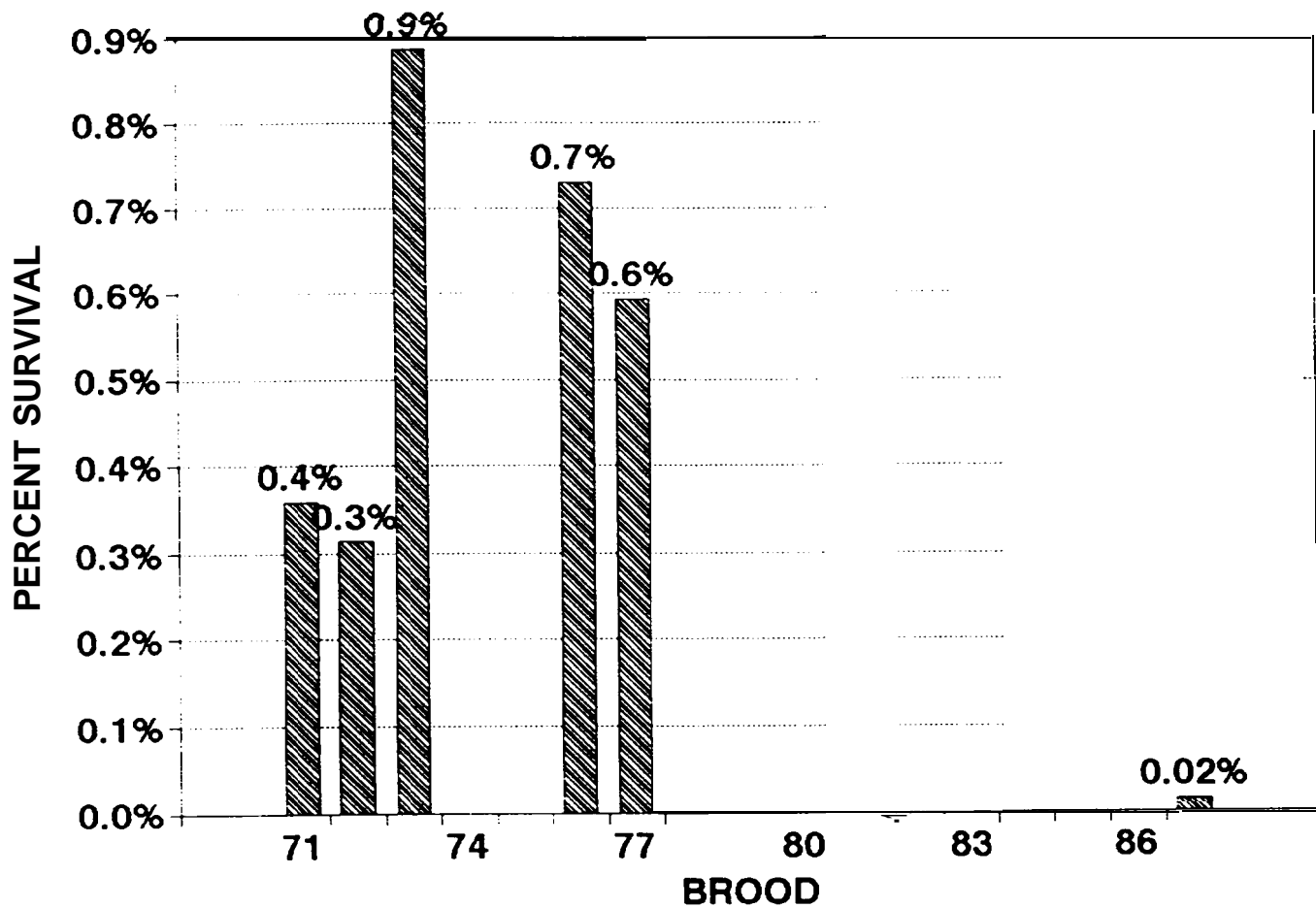


Figure 15. Survival of Toutle river fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Toutle Hatchery Fall Chinook Subyearling Releases, 1987 Brood Only

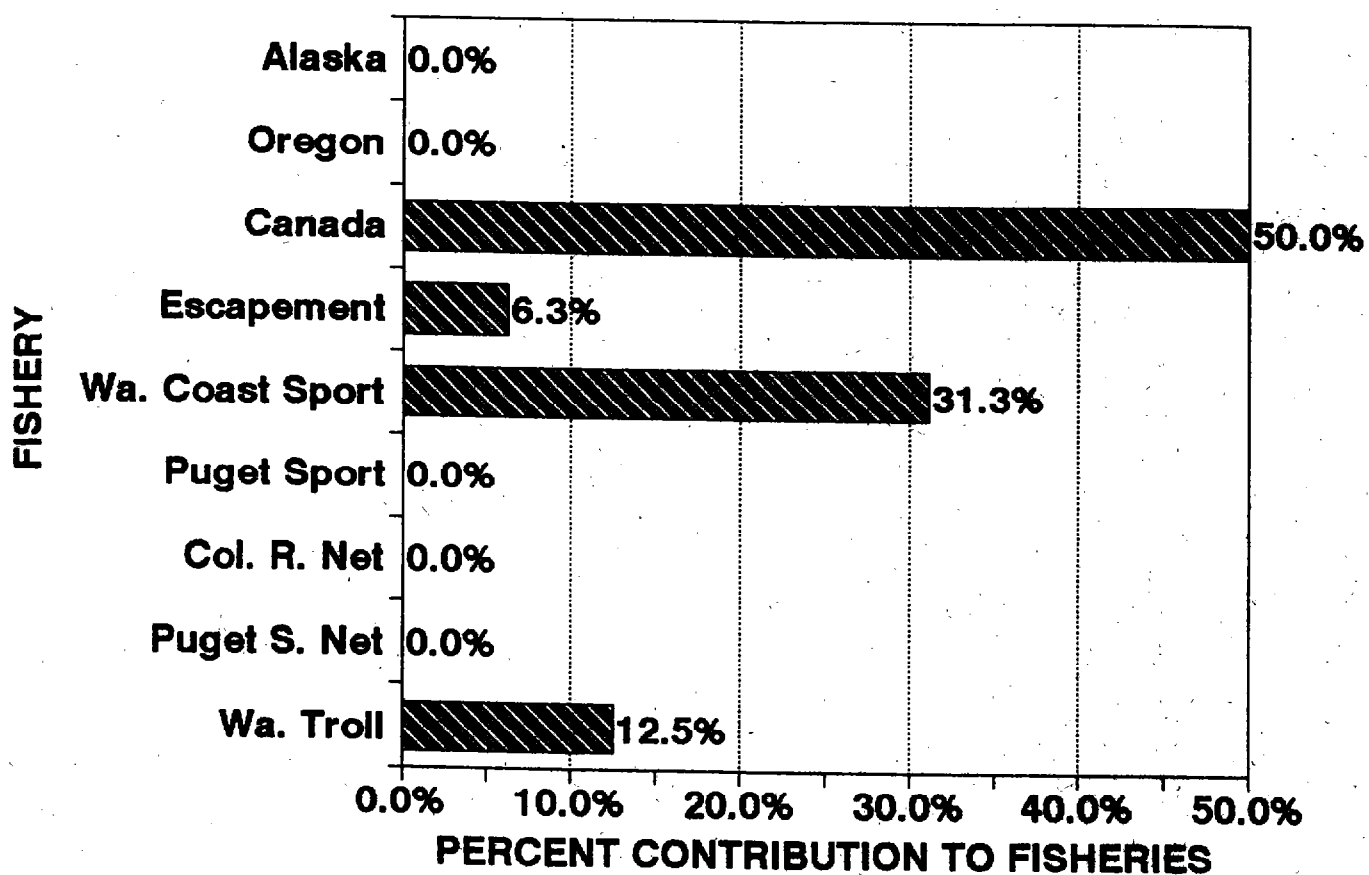


Figure 16. Percent contribution to fisheries and escapement for 1987 brood Toutle tle fall chinook.

Toutle Hatchery Coho

Type-S Coho

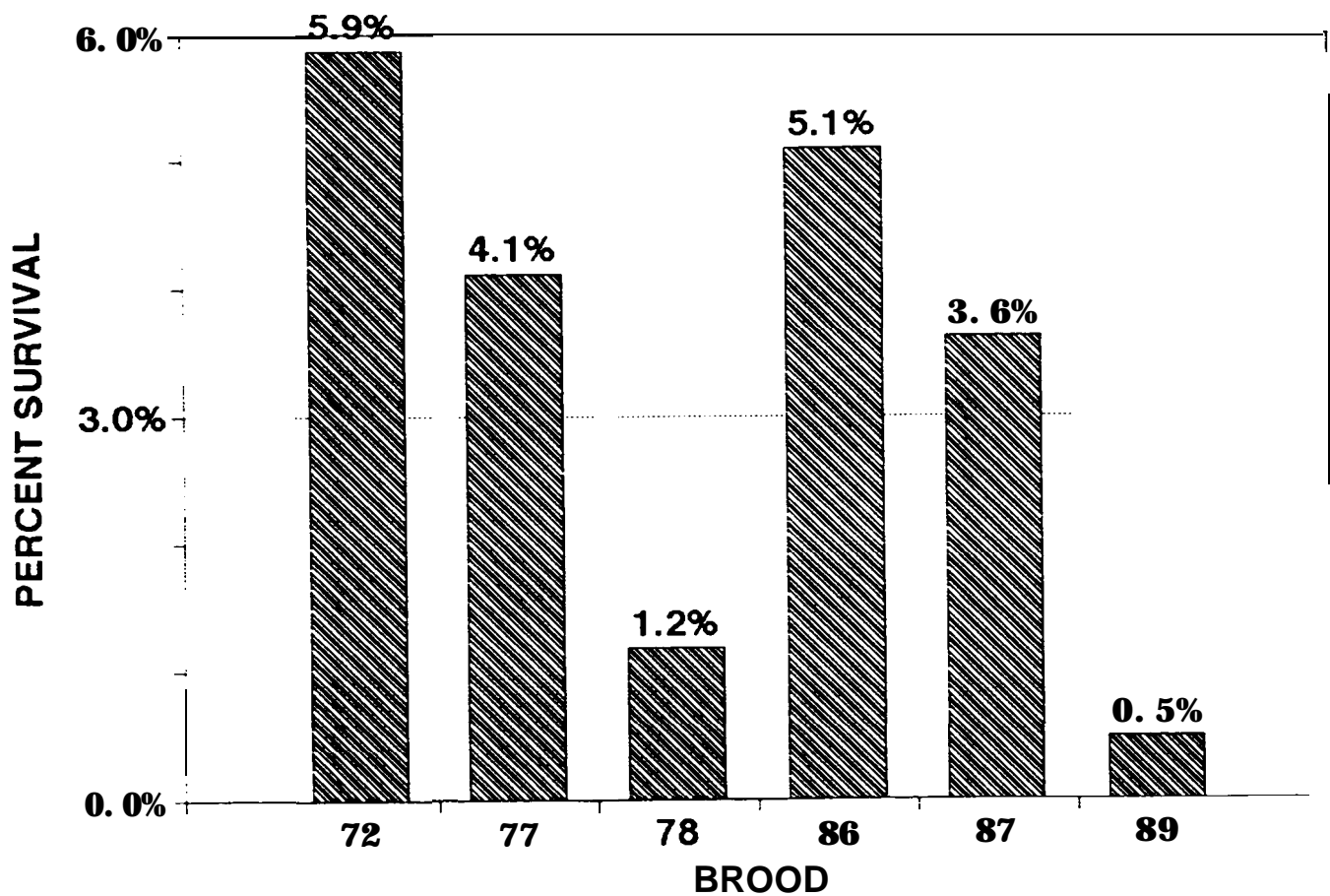


Figure 17. Survival of Toutle Type-s coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Toutle Hatchery Coho

Type-S Coho, 1989 Brood

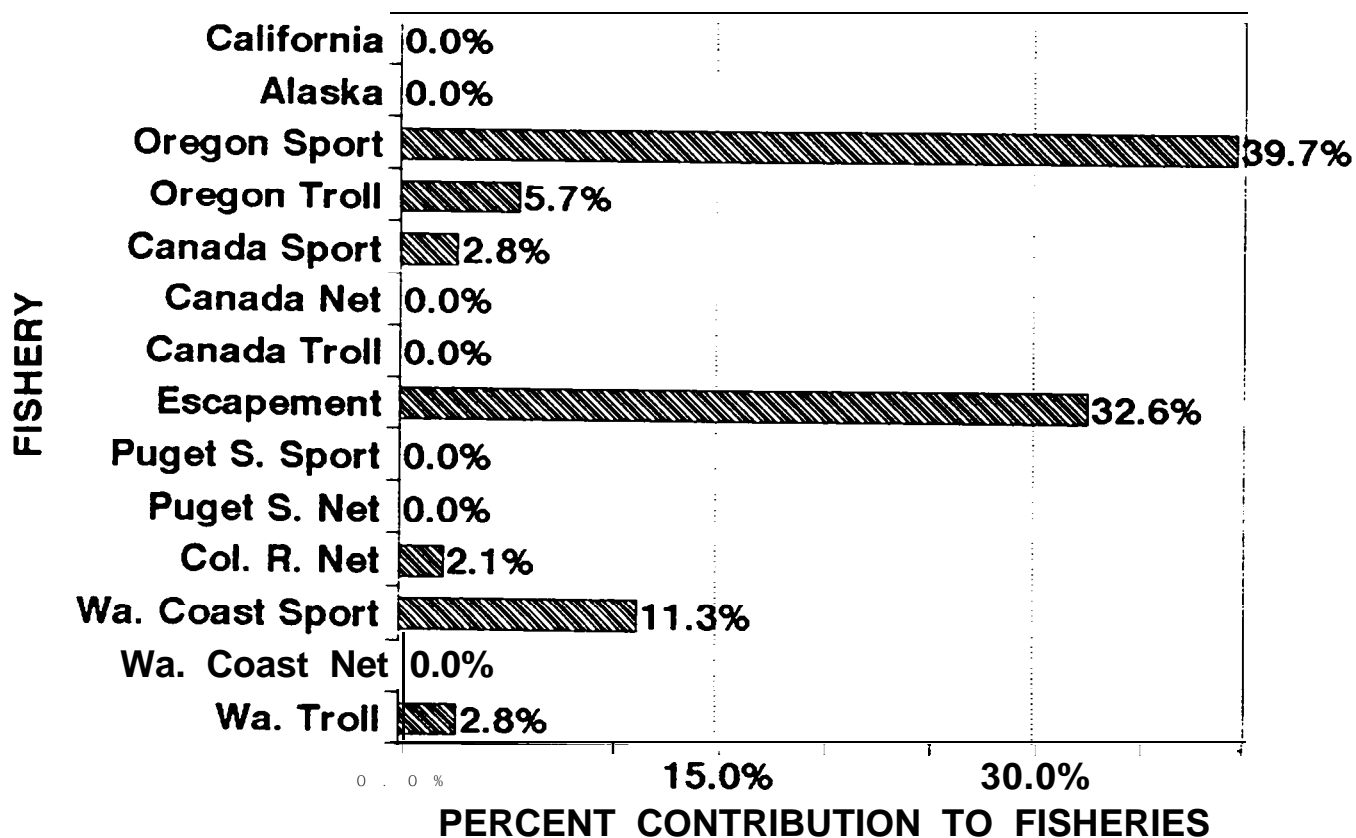


Figure 18. Percent contribution to fisheries and escapement for 1989 brood Toutle Type-S coho.

Lower Kalama Hatchery Fall Chinook Subyearlings only

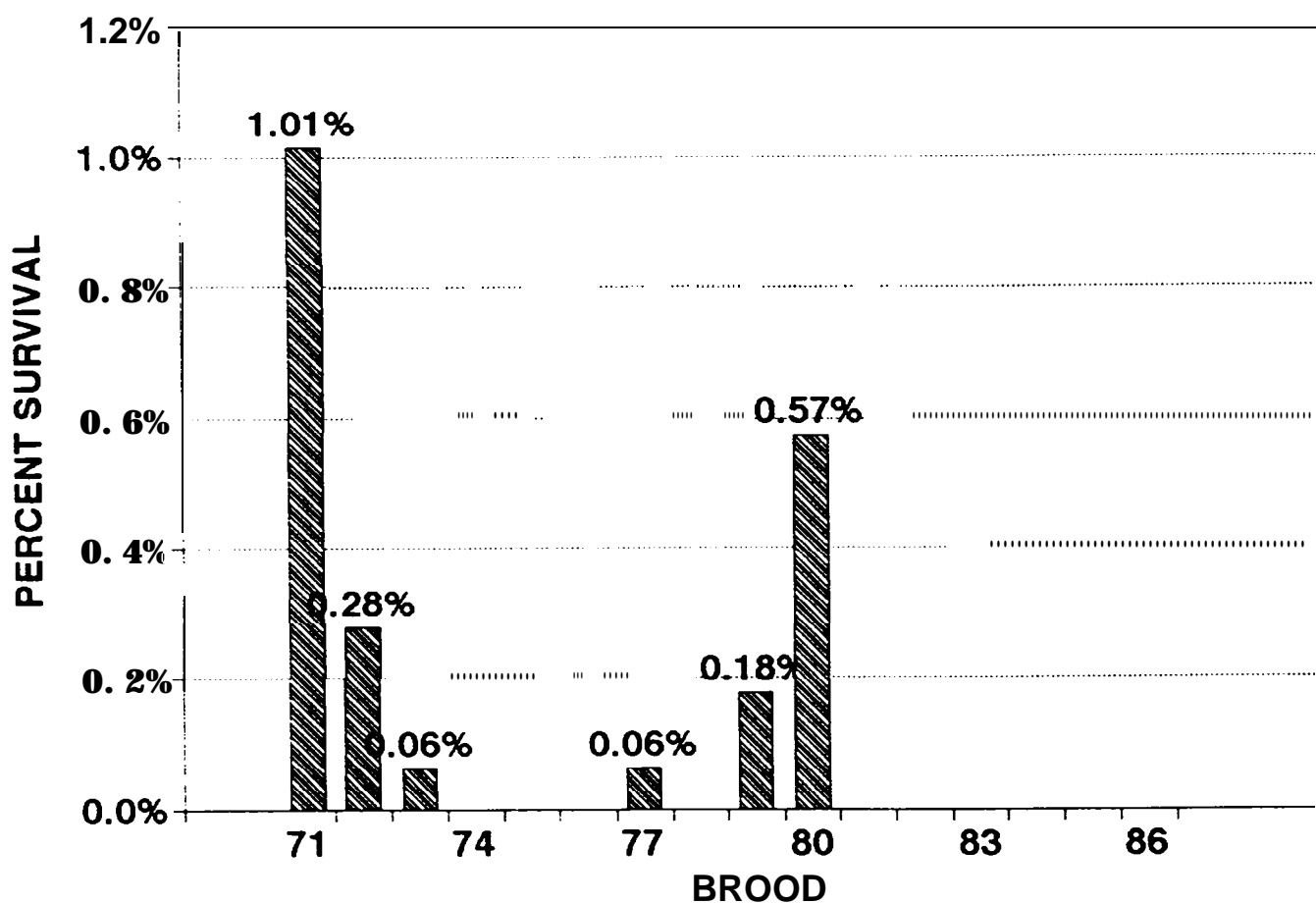


Figure 19. Survival of Lower Kalama tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lower Kalama Hatchery Coho

Type-N Coho

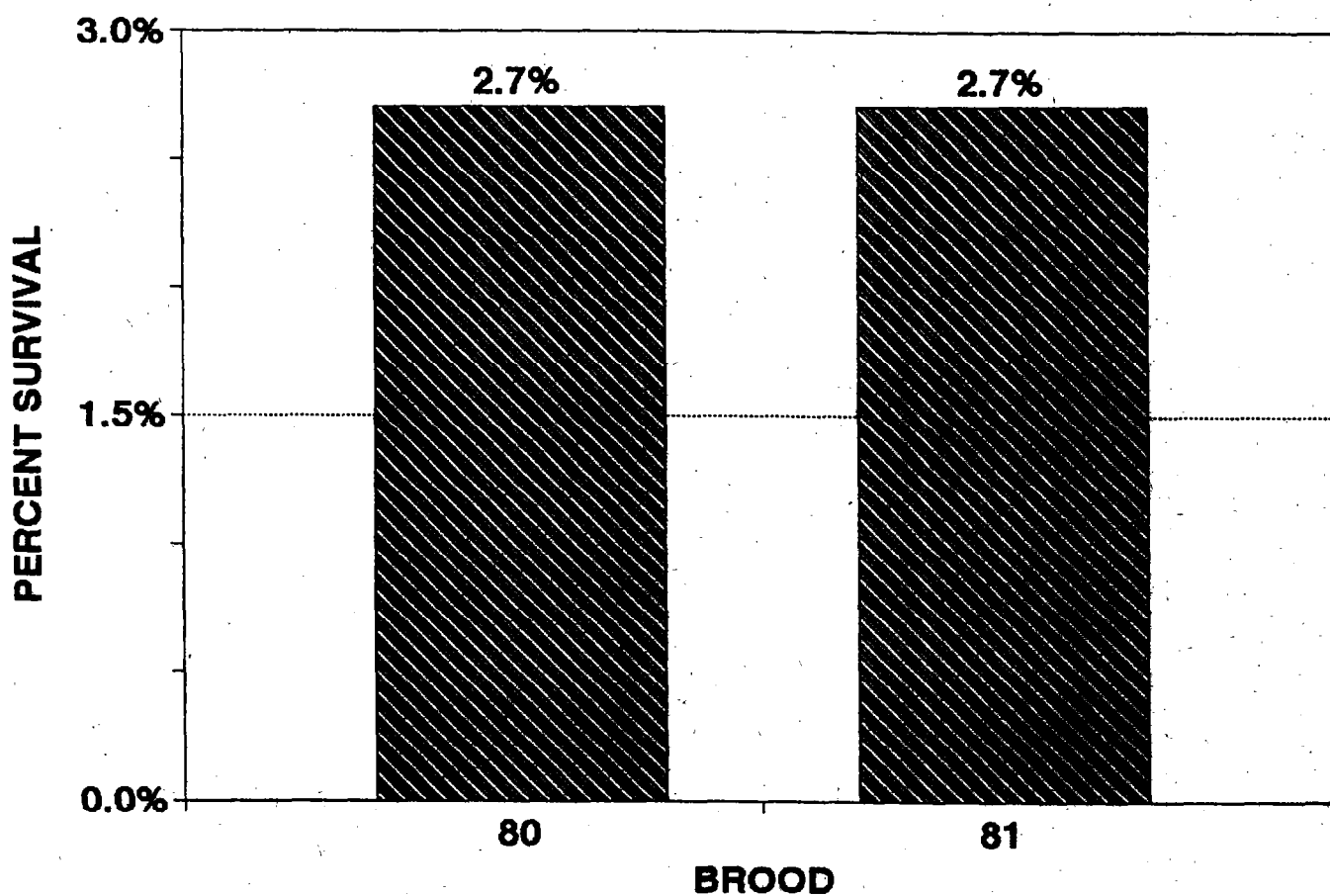


Figure 20. Survival of Lower Kalama Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lower Kalama Hatchery Coho Type-S Coho

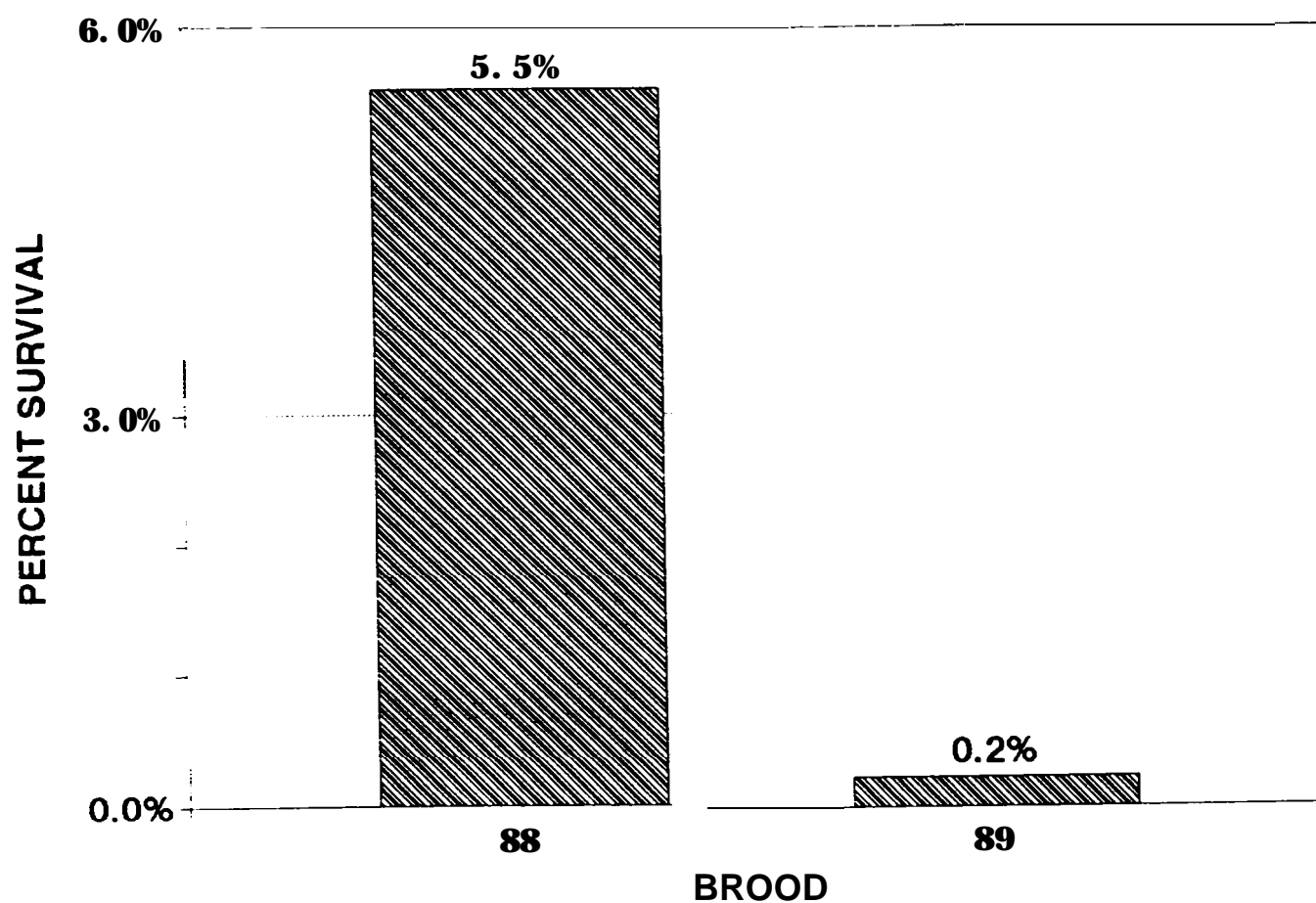


Figure 21. Survival of Lower Kalama Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lower Kalama Hatchery Coho

Type-S Coho, 1988 & 1989 Brood

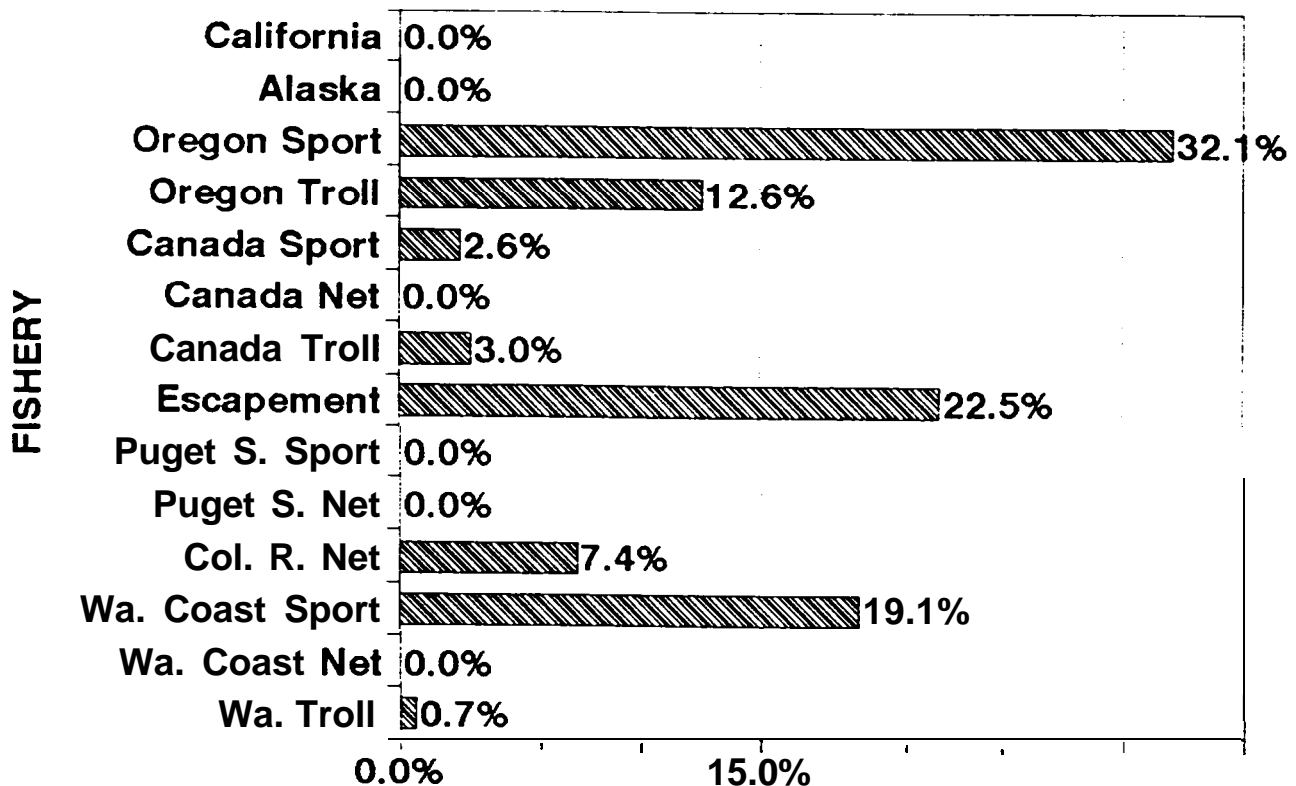


Figure 22. Average percent contribution of Lower Kalama Type-S coho to fisheries and

Kalama Falls Hatchery Fall Chinook

Survivals by brood, subyearlings only

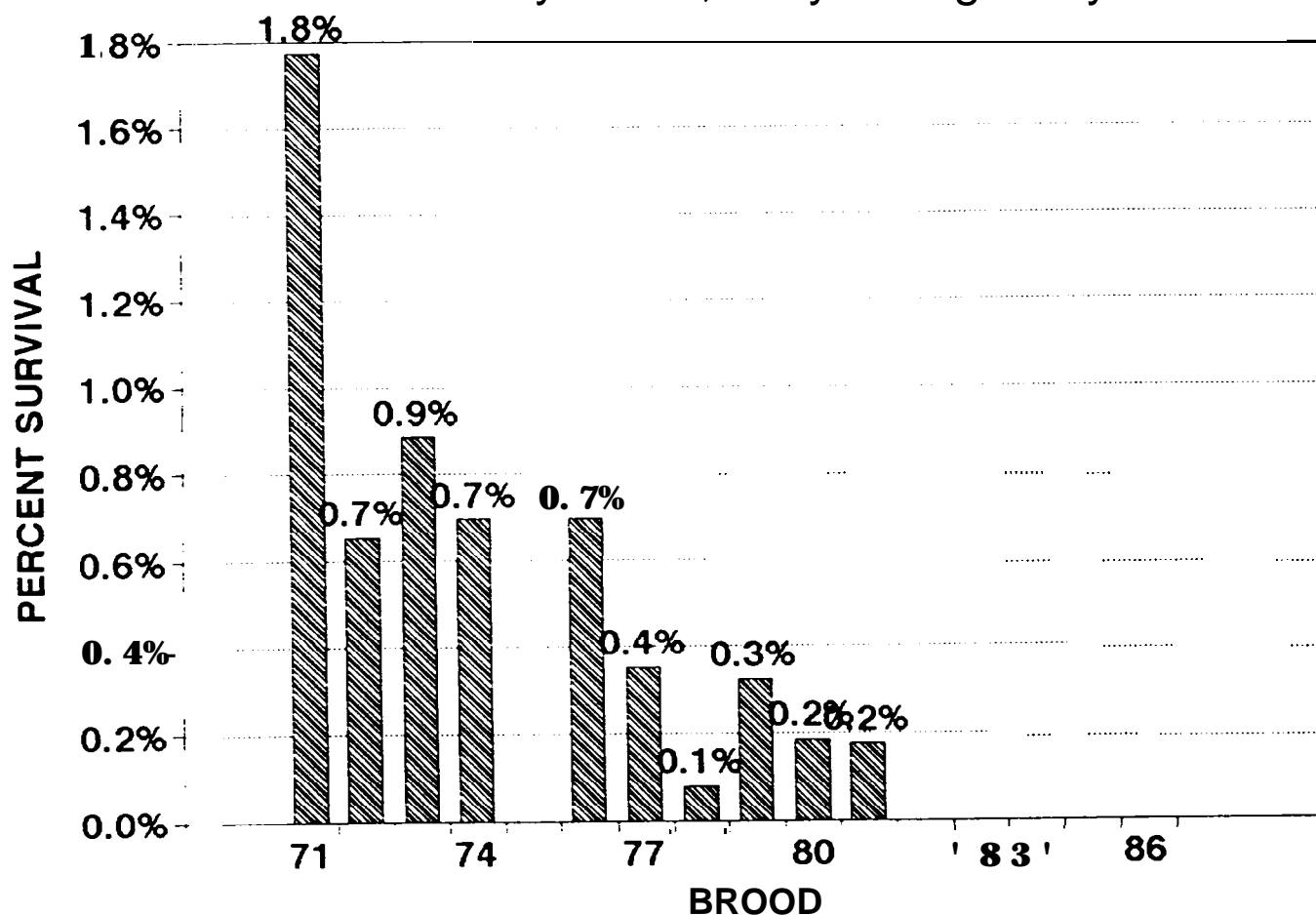


Figure 23. Survival of Kalama Falls tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Kalama Falls Hatchery Spring Chinook Yearling Releases

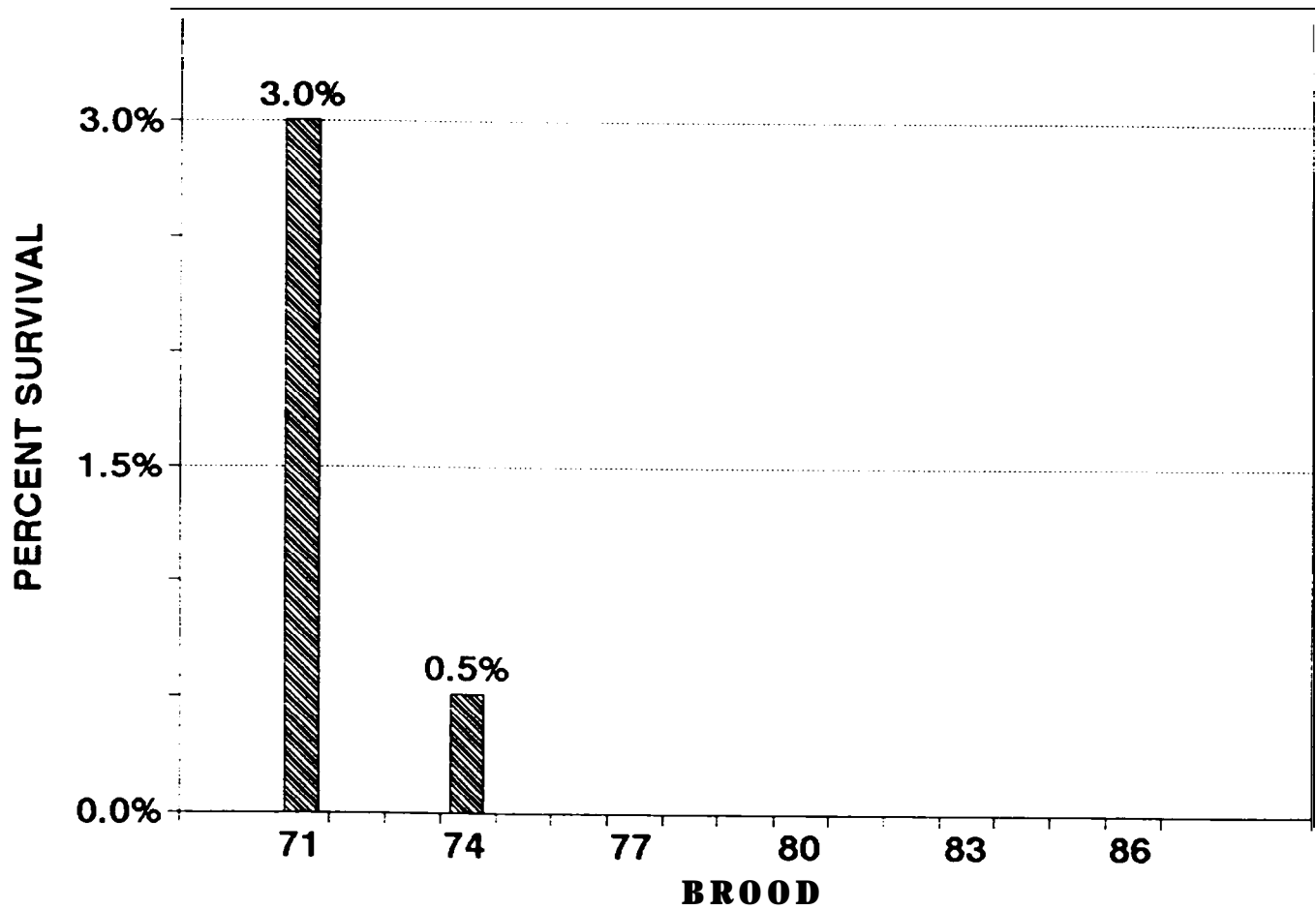


Figure 24. Survival of Kalama spring chinook by brood. Tagged releases originated from either Kalama hatchery depending on brood year.

Kalama Falls Hatchery Coho

Type-N Coho

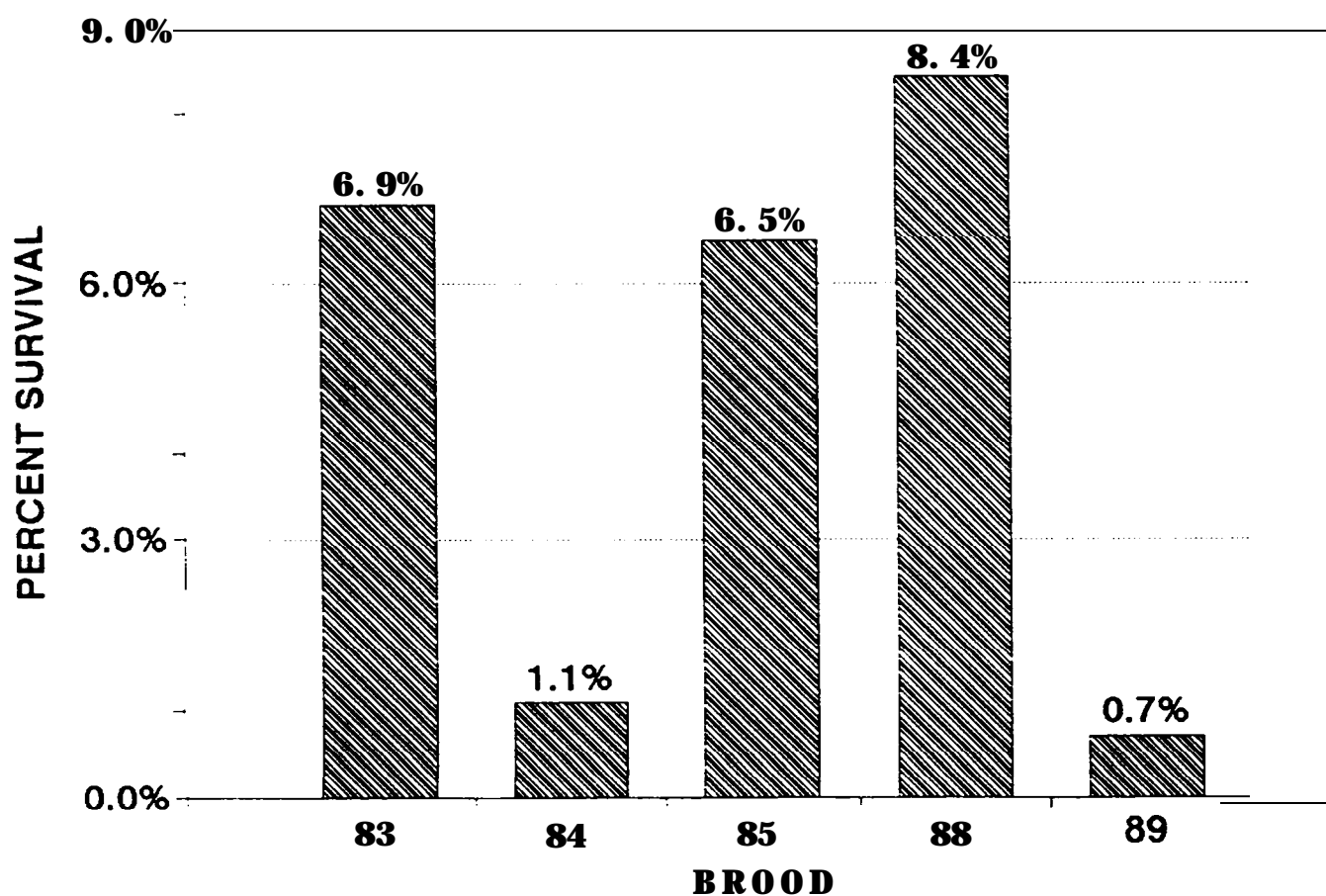


Figure 25. Survival of Kalama Falls Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Kalama Falls Hatchery Coho

Type-N Coho, 1988 & 1989 Broods

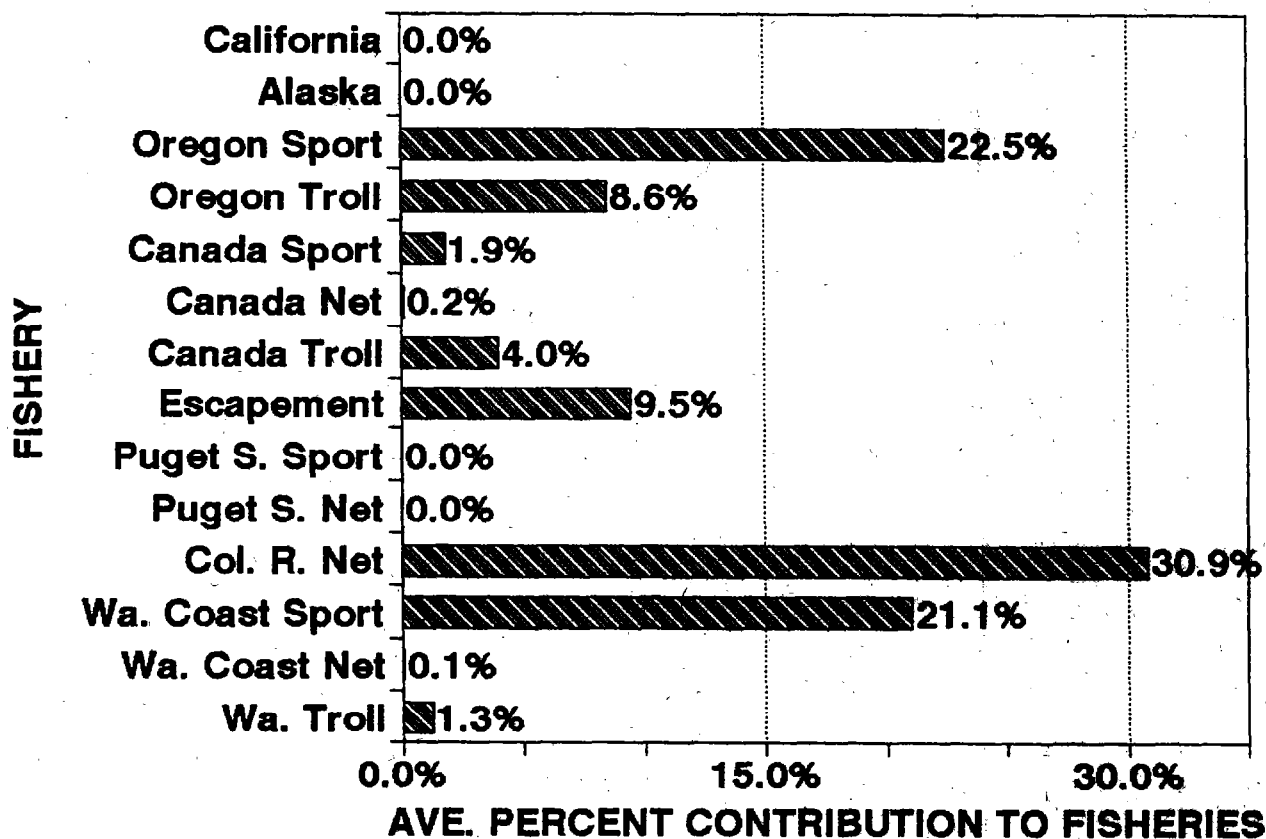


Figure 26. Average percent contribution of Kalama Falls Type-N coho to fisheries and escapement for broods 1988 and 1989.

Lewis River Wild Chinook

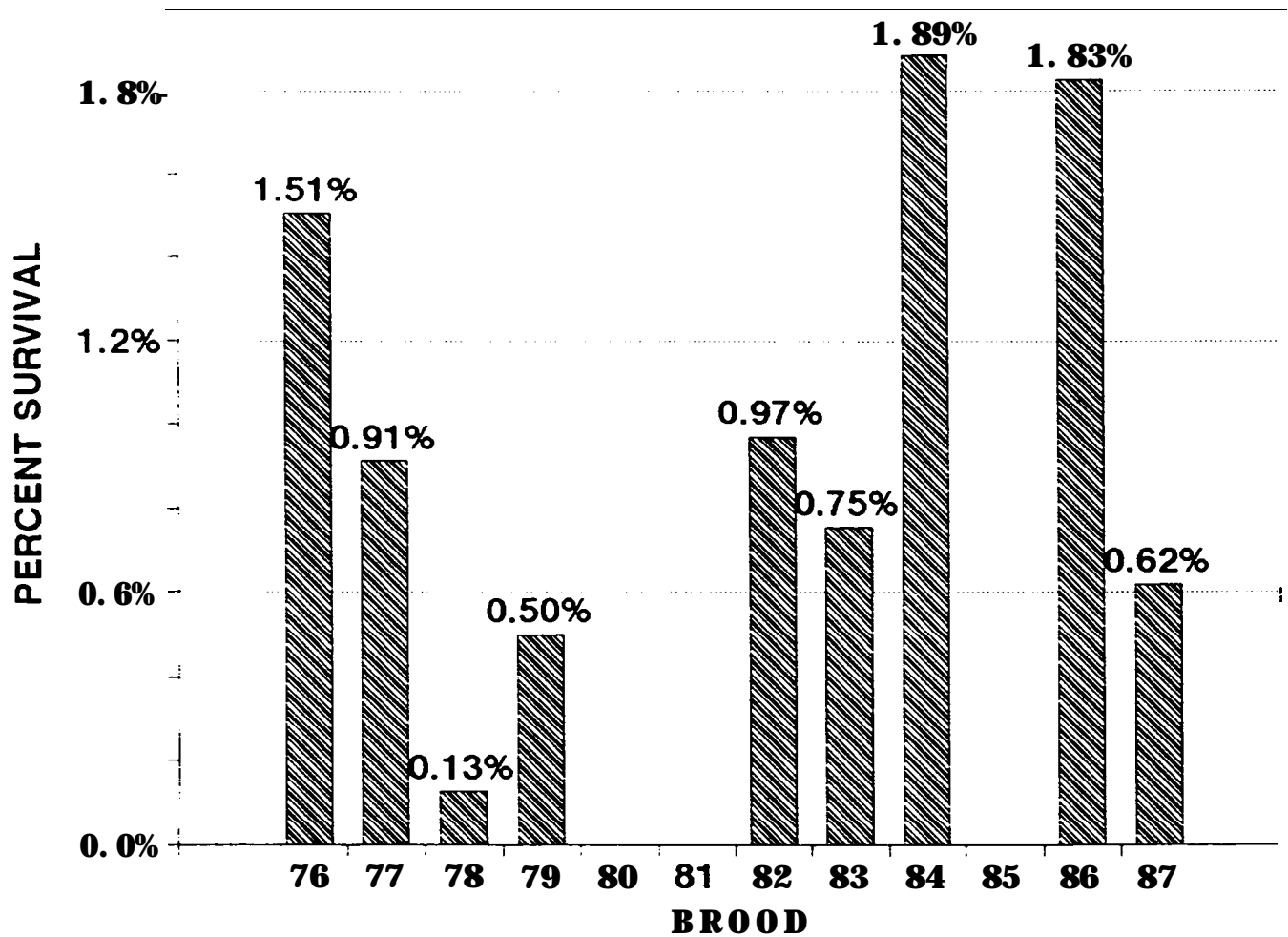


Figure 27. Survivals of Lewis River wild fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lewis River Wild Chinook 1986 & 1987 Broods

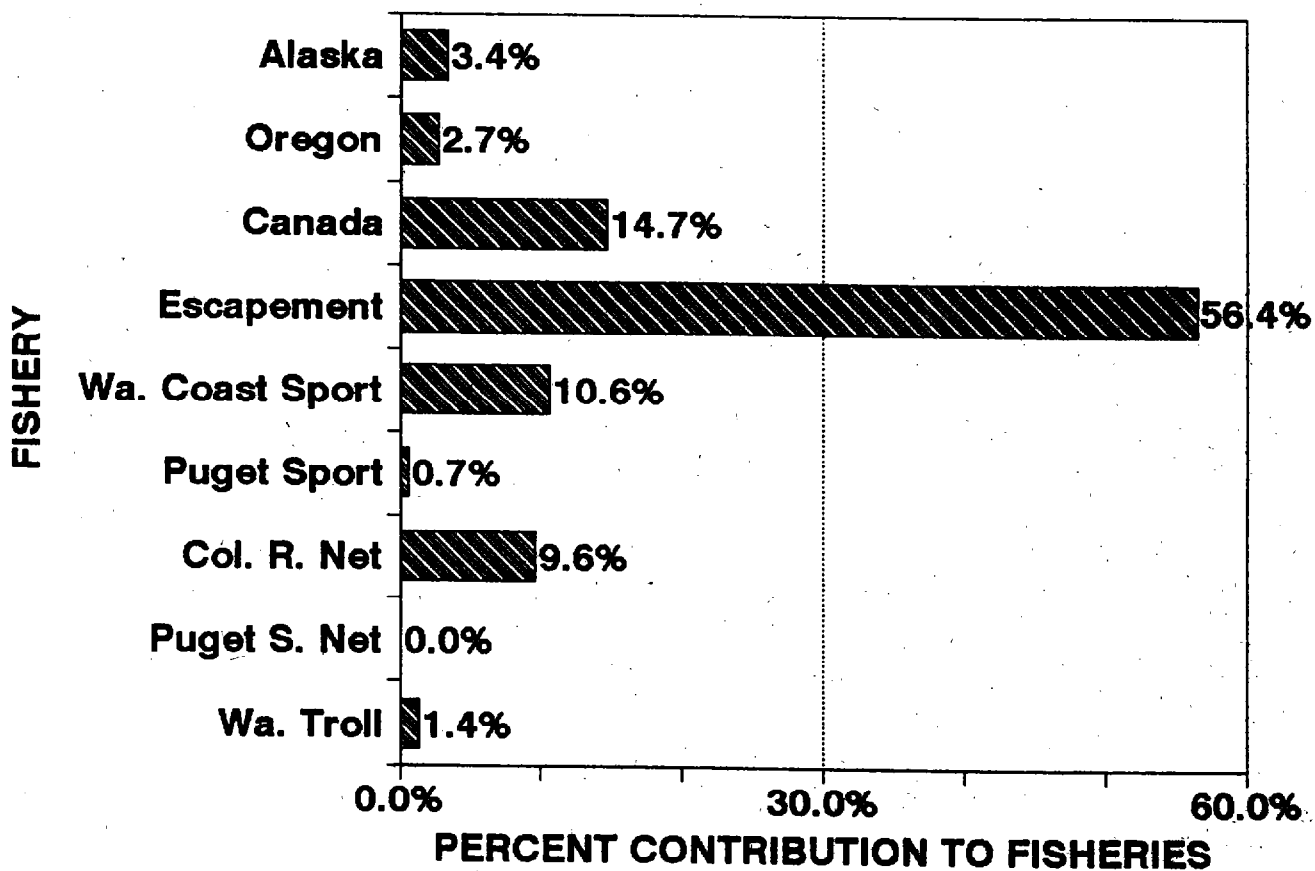


Figure 28. Average percent contribution of Lewis River wild fall chinook to fisheries and escapement for broods 1986 and 1987.

Lewis River Hatchery Coho Type-N Coho

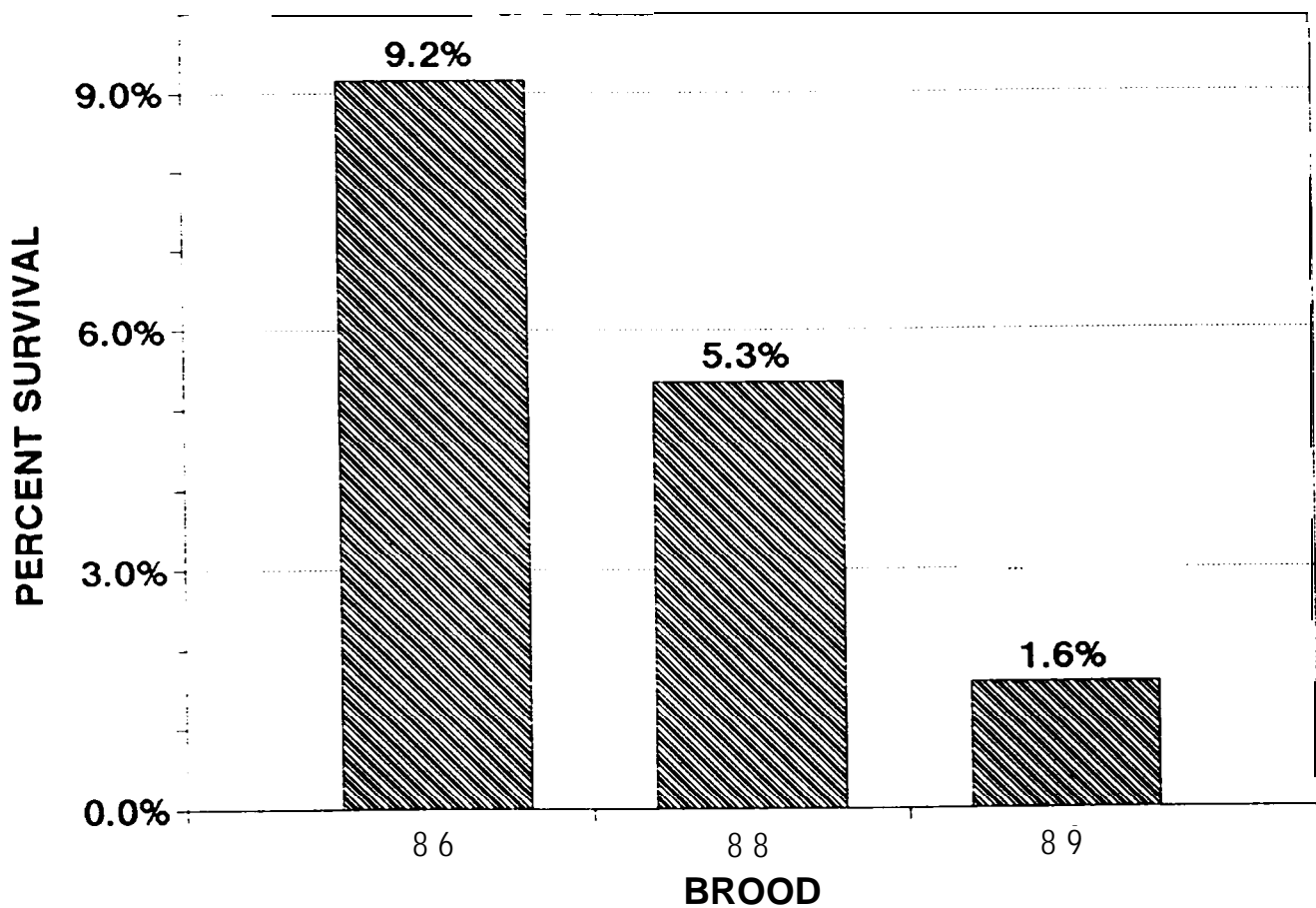


Figure 29. Survivals of Lewis River Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lewis River Hatchery Coho

Type-N Coho, 1988 & 1989 Broods

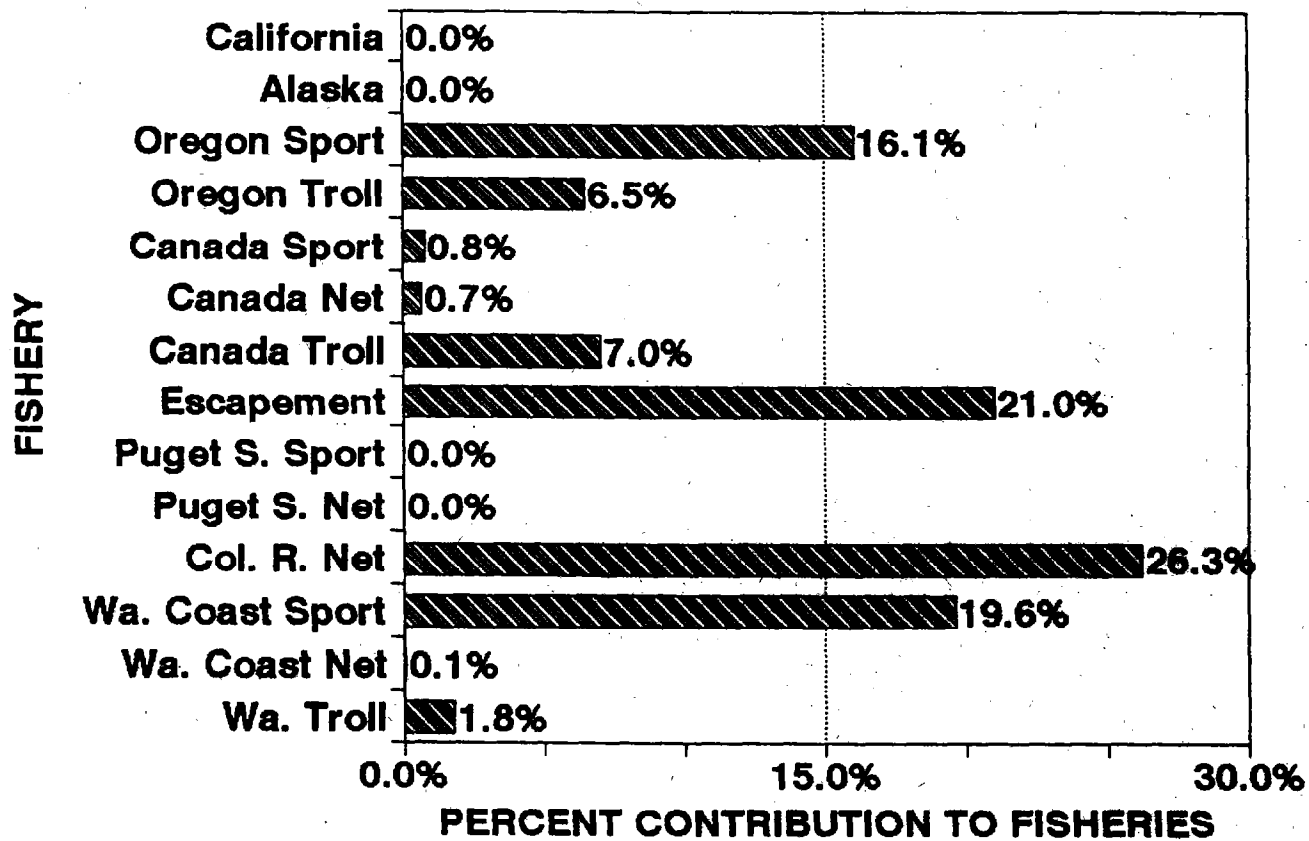


Figure 30. Average percent contribution of Lewis River Type-N coho to fisheries and escapement for broods 1988 and 1989.

Lewis River Hatchery Coho Type-S Coho

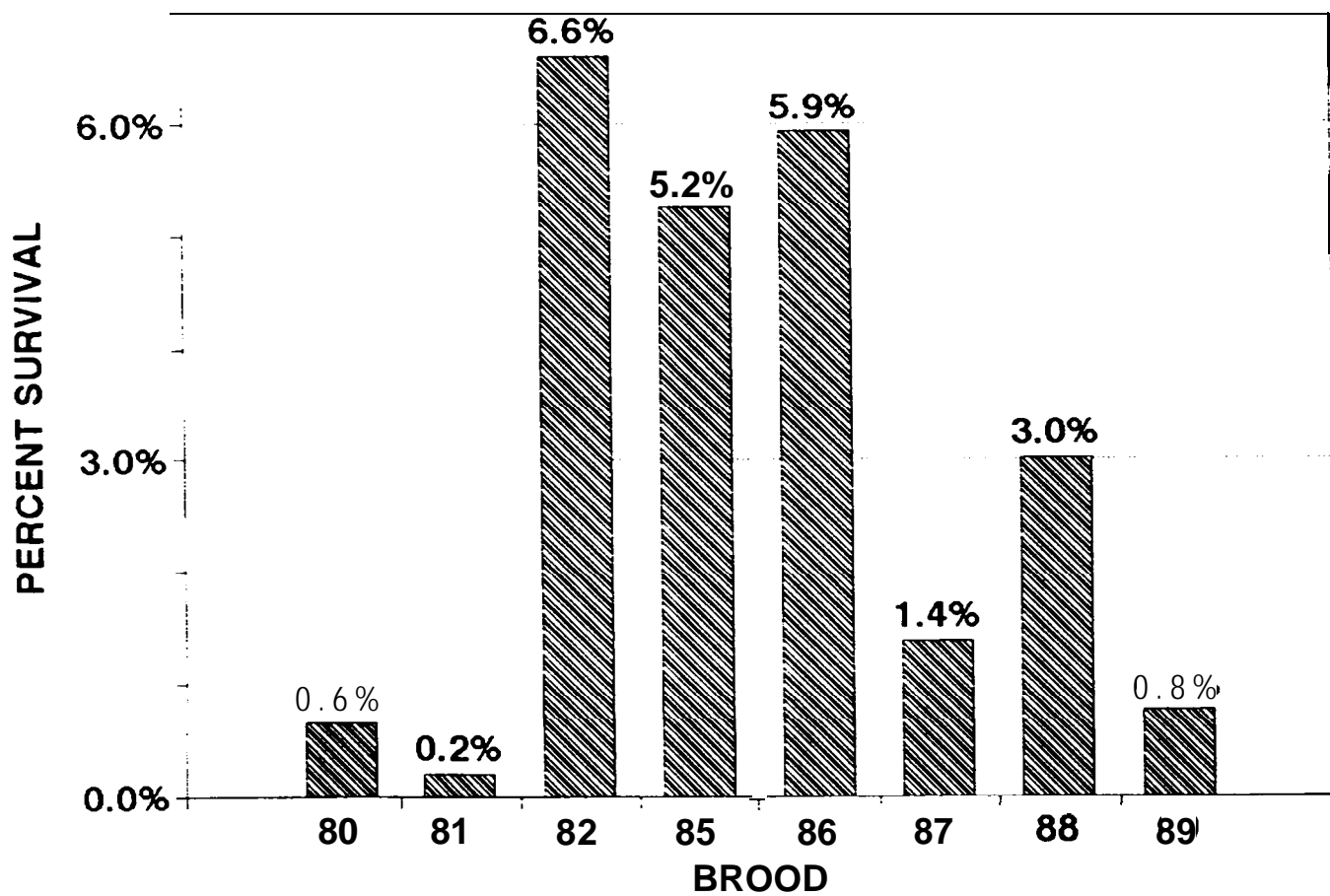


Figure 31. Survivals of Lewis River Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Lewis River Hatchery Coho

Type-S Coho, 1988 & 1989 Broods

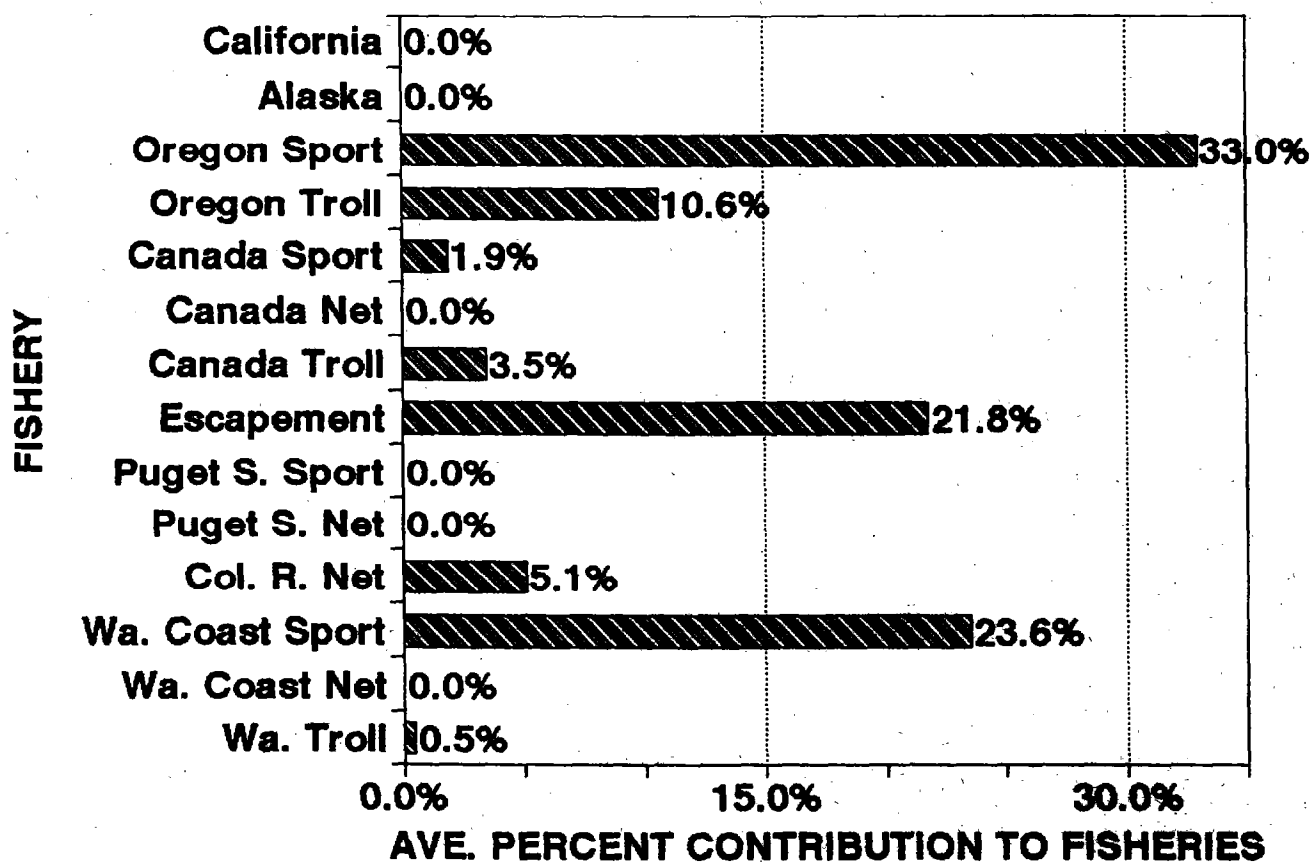


Figure 32. Average percent contribution of Lewis River Type-S coho to fisheries and escapement for broods 1988 and 1989.

Washougal Hatchery Fall Chinook

Subyearlings only

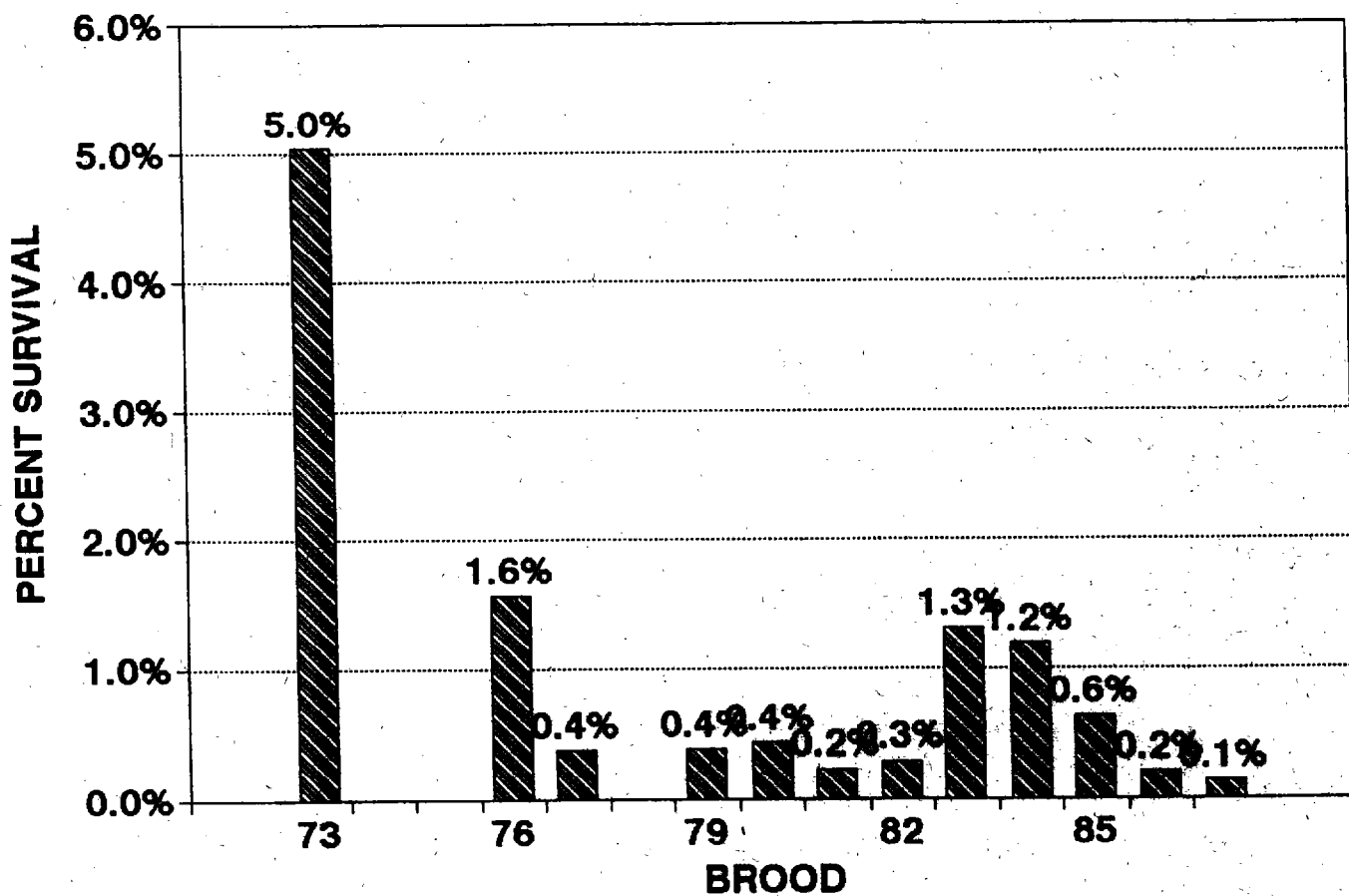


Figure 33. Survival of Washougal tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Washougal Hatchery Fall Chinook Subyearling Releases, 1986 & 1987 Broods

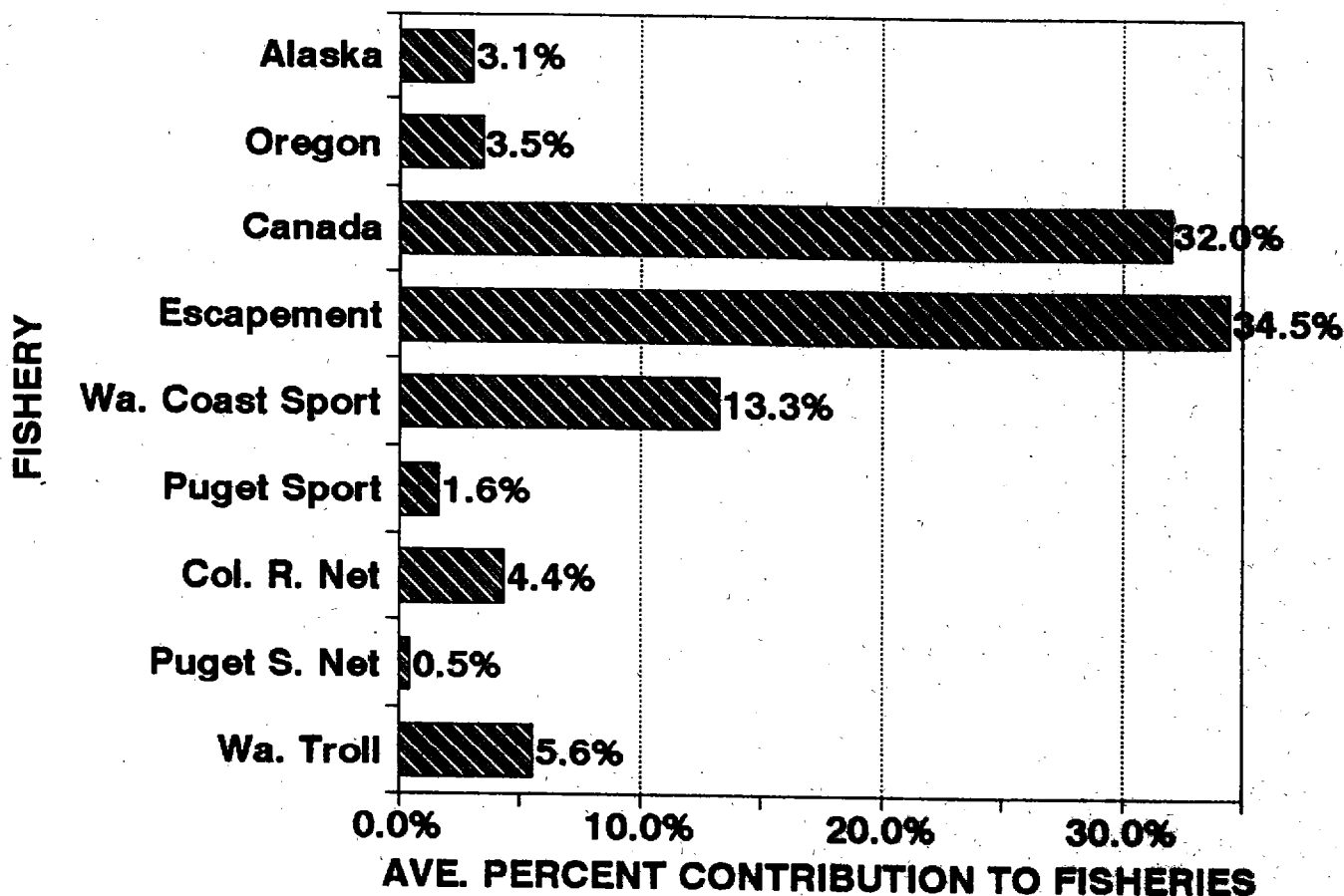


Figure 34. Average percent contribution of Washougal tule fall chinook to fisheries and escapement for broods 1986 and 1987.

Washougal Hatchery Coho, (On-Station) Type-N Coho

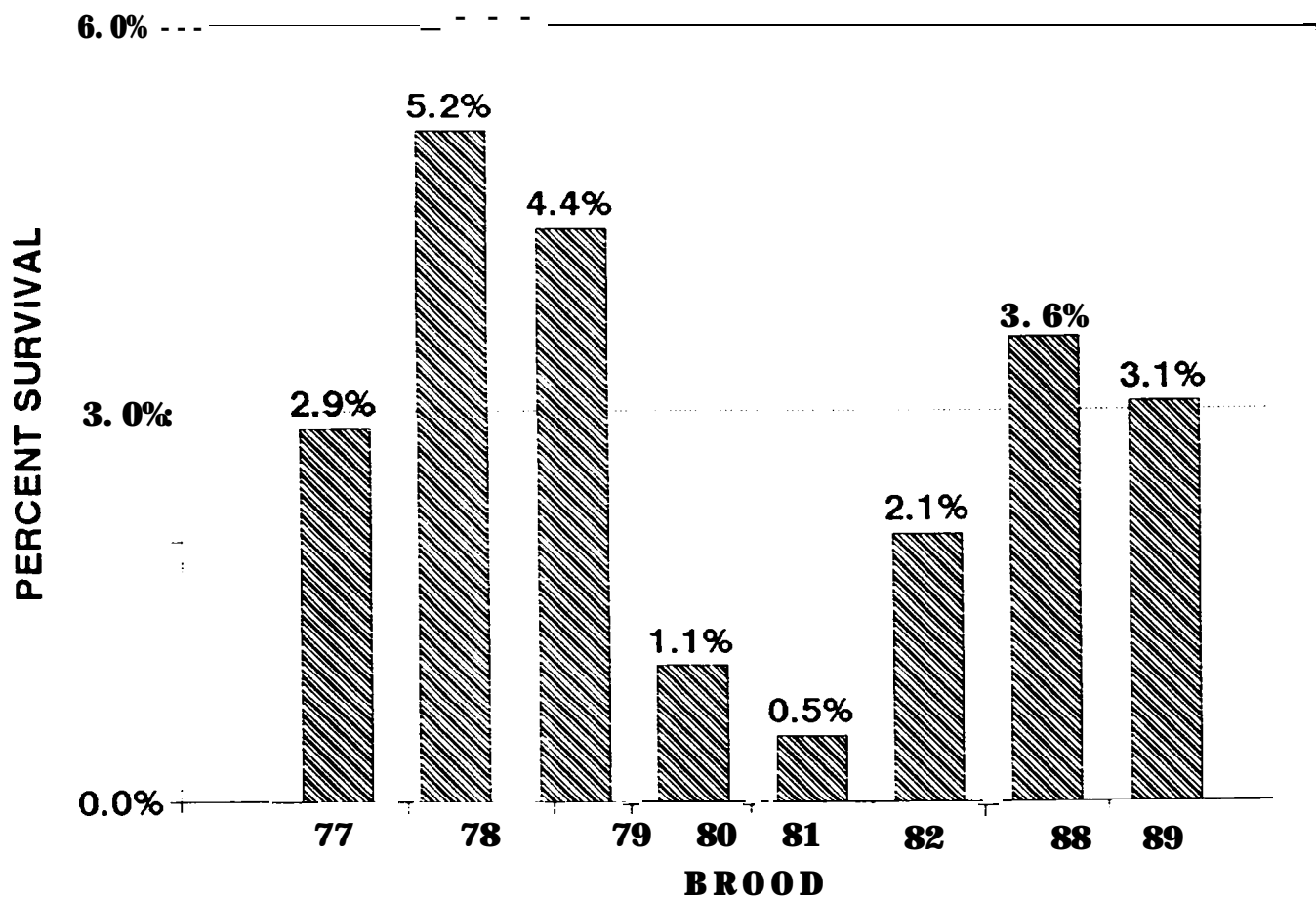


Figure 35. Survival of Washougal Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Washougal Hatchery Coho, (On-Station) Type-N Coho, 1988 & 1989 Broods

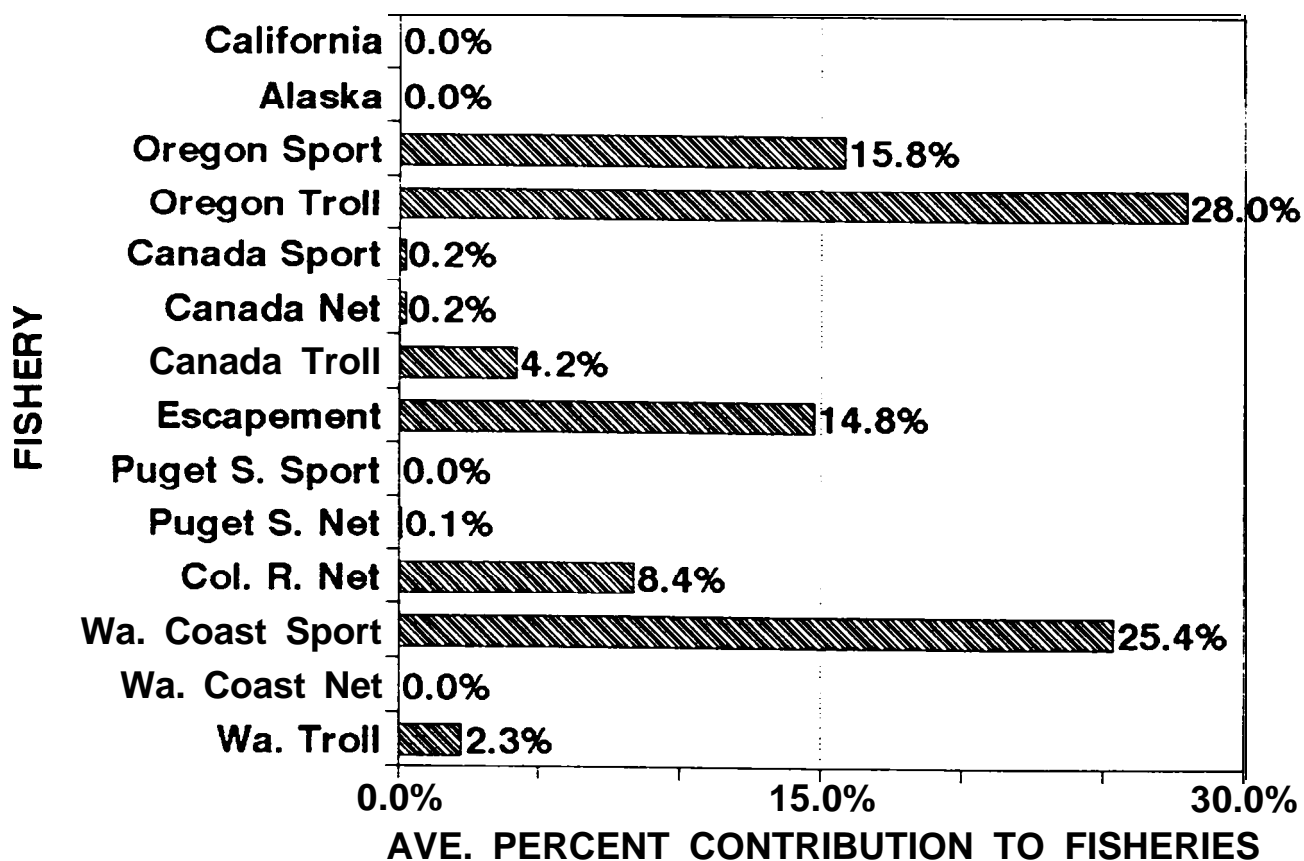


Figure 36. Average percent contribution of Washougal Type-N coho to fisheries and escapement for broods 1988 and 1989.

Washougal Hatchery Coho, (On-Station) Type-S Coho

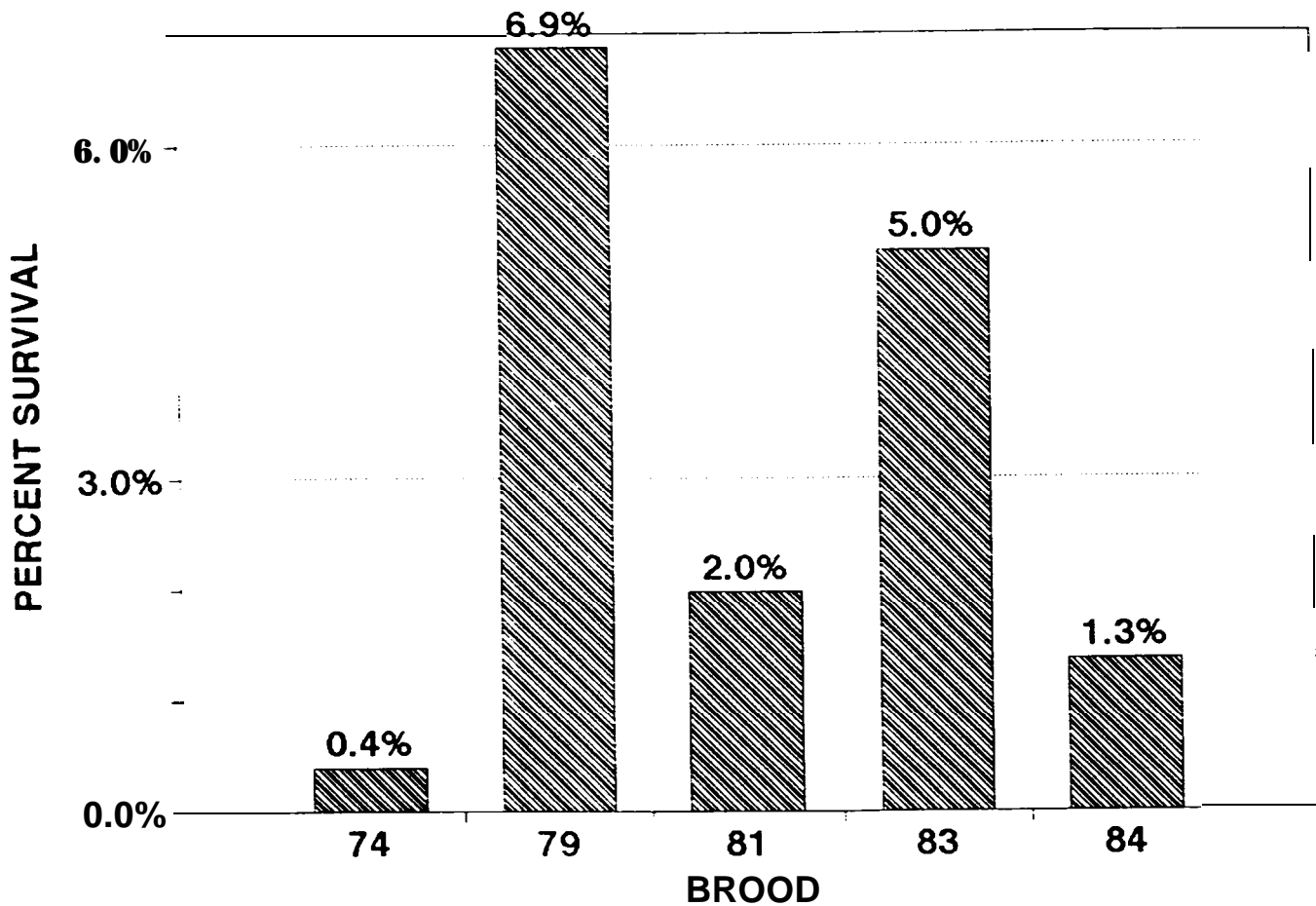


Figure 37. Survival of Washougal Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Washougal Hatchery Coho, (Klickitat Rel) Type-N Coho

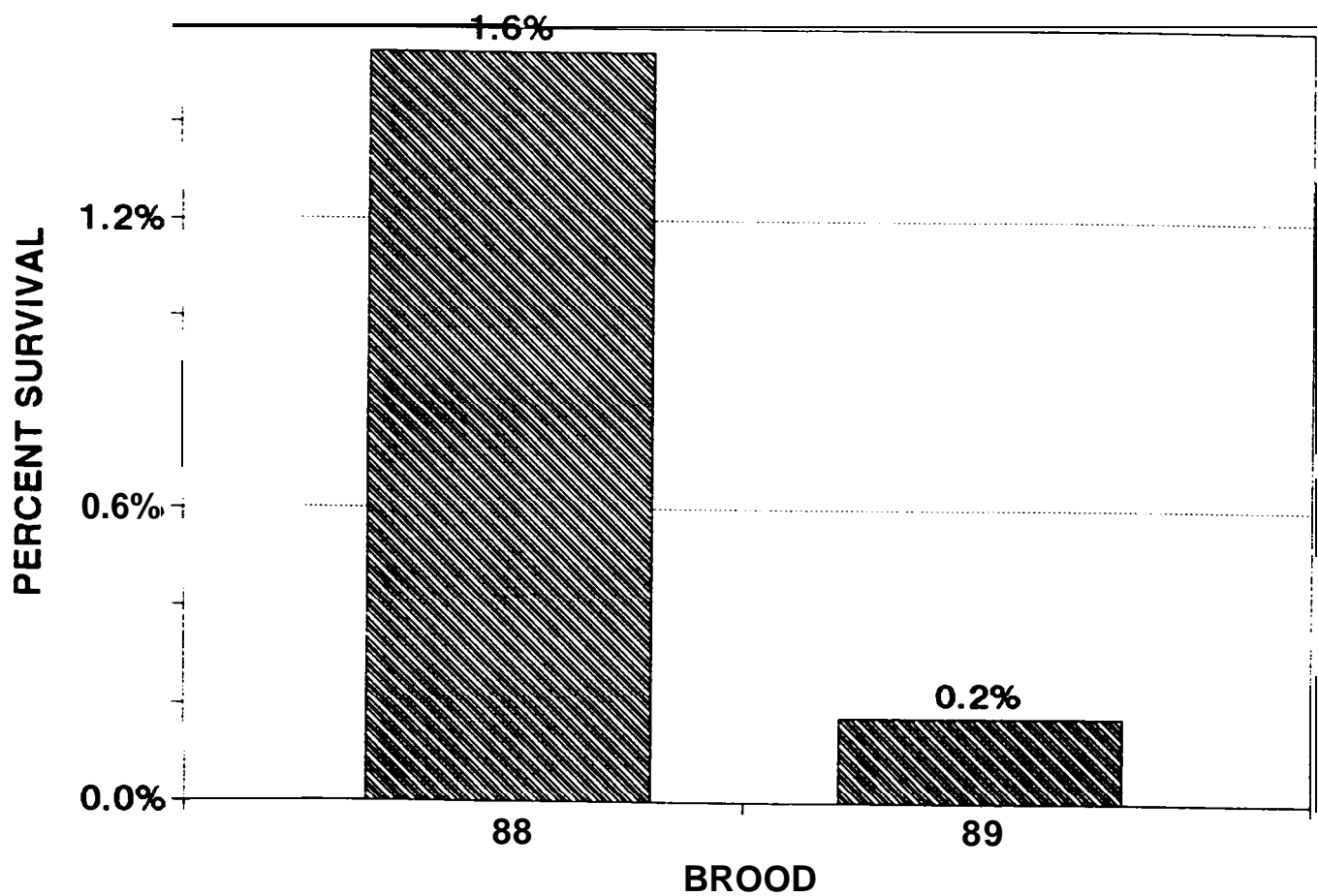


Figure 38. Average survival by brood of Washougal Type-N coho transported to the Klickitat River for release.

Washougal Hatchery Coho, (Klickitat Rel) Type-N Coho, 1988 & 1989 Broods

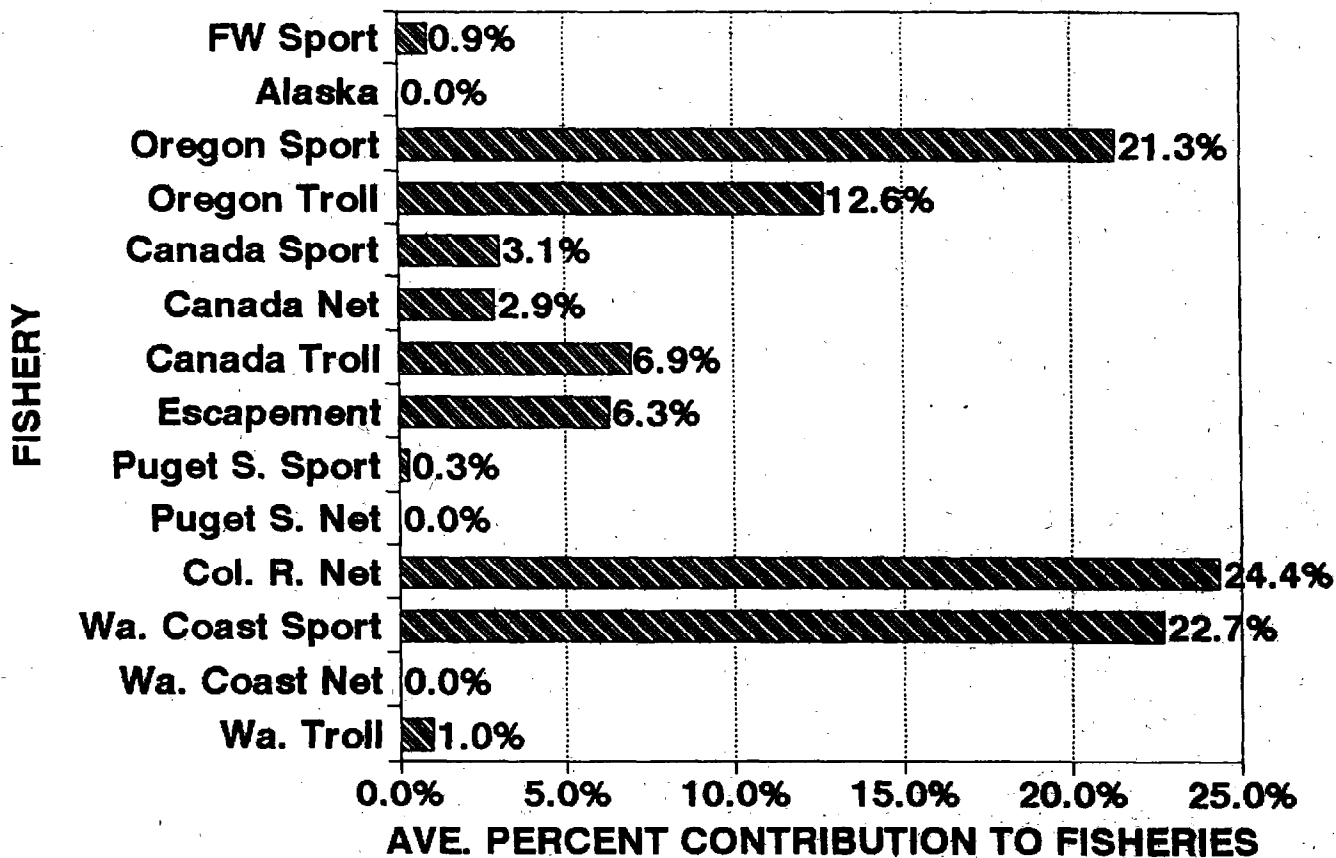


Figure 39. Average percent contribution to fisheries and escapement for broods 1988 and 1989 of Washougal Type-N coho transported to the Klickitat River.

Klickitat Hatchery Fall Chinook Subyearlings only

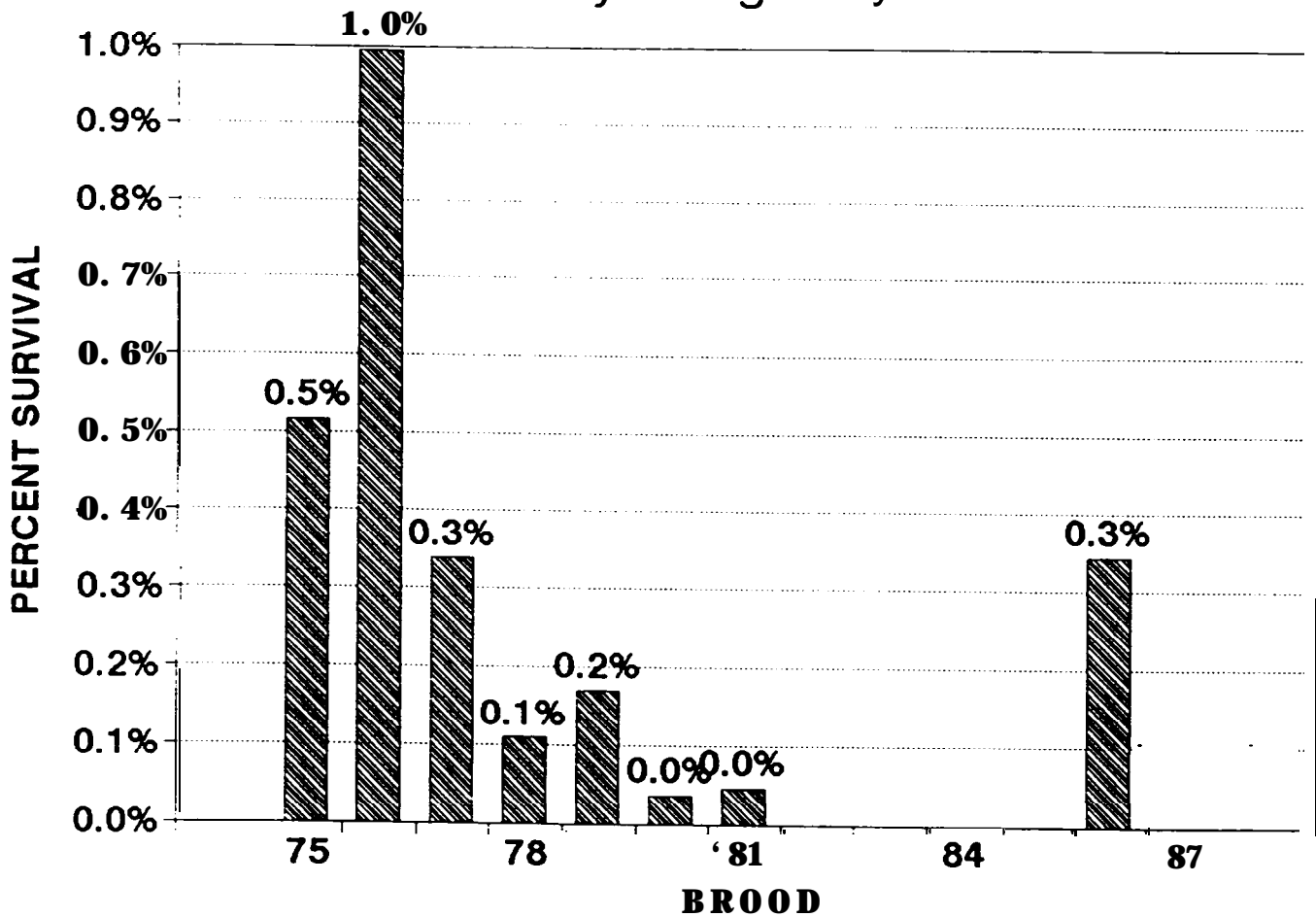


Figure 40. Survival of Klickitat fall chinook by brood. Includes releases of tule and upriver bright stock of chinook. Some years represent an average of several tagged releases and others a single point estimate of survival.

Klickitat Hatchery Fall Chinook

Subyearlings only, 1986 brood

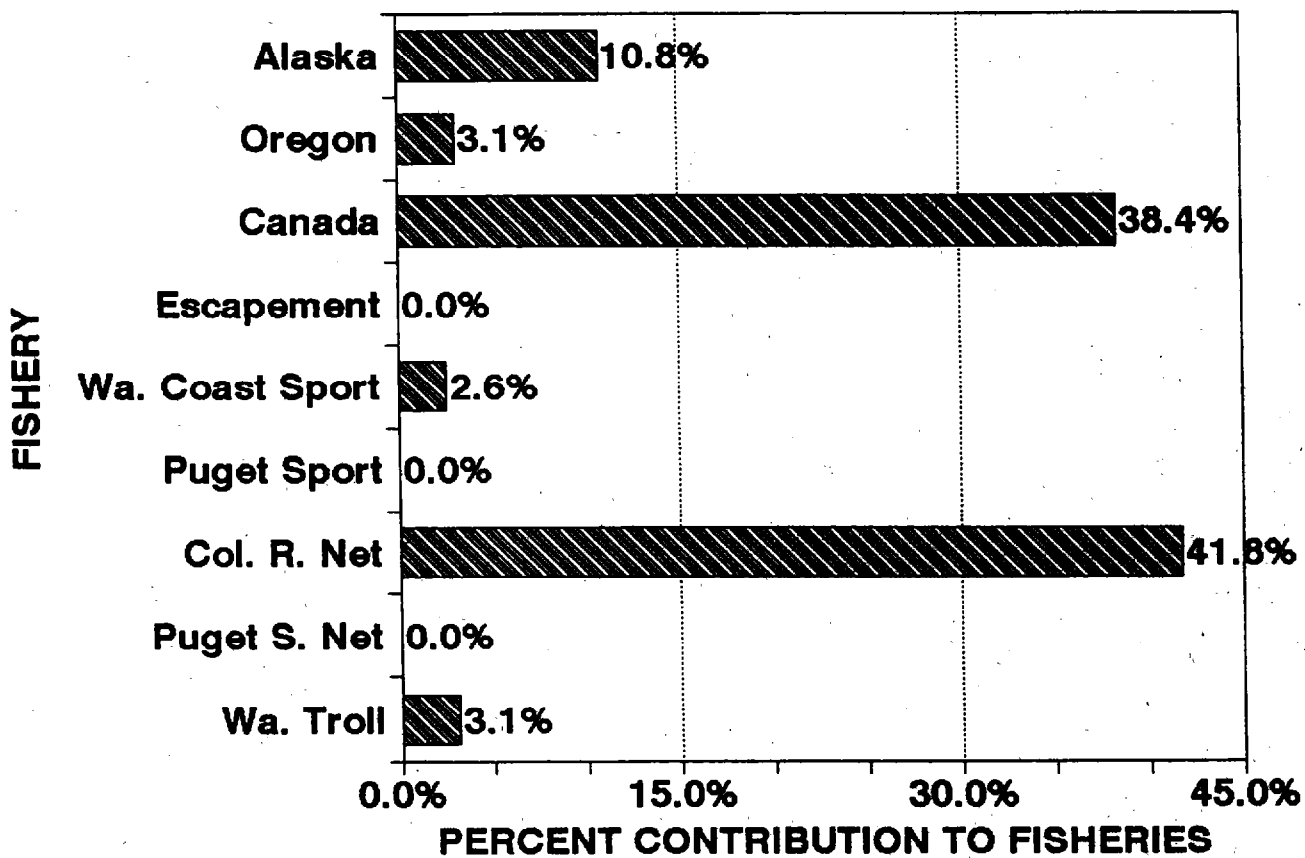


Figure 41. Percent contribution of Klickitat fall chinook to fisheries and escapement for the 1986 brood.

Klickitat Hatchery Spring Chinook Yearling Releases

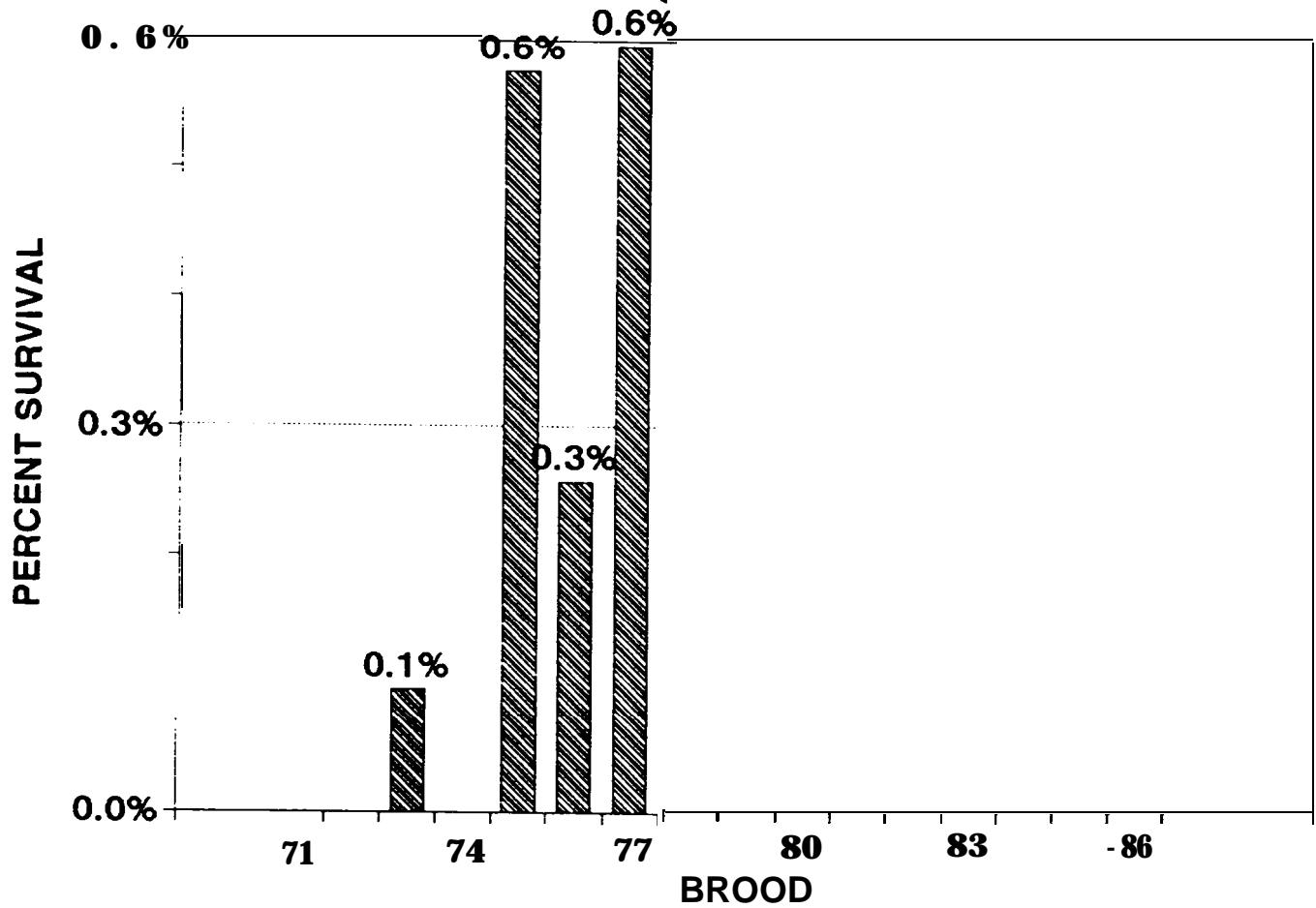


Figure 42. Survival of Klickitat spring chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Klickitat Hatchery Coho

Type-N Coho

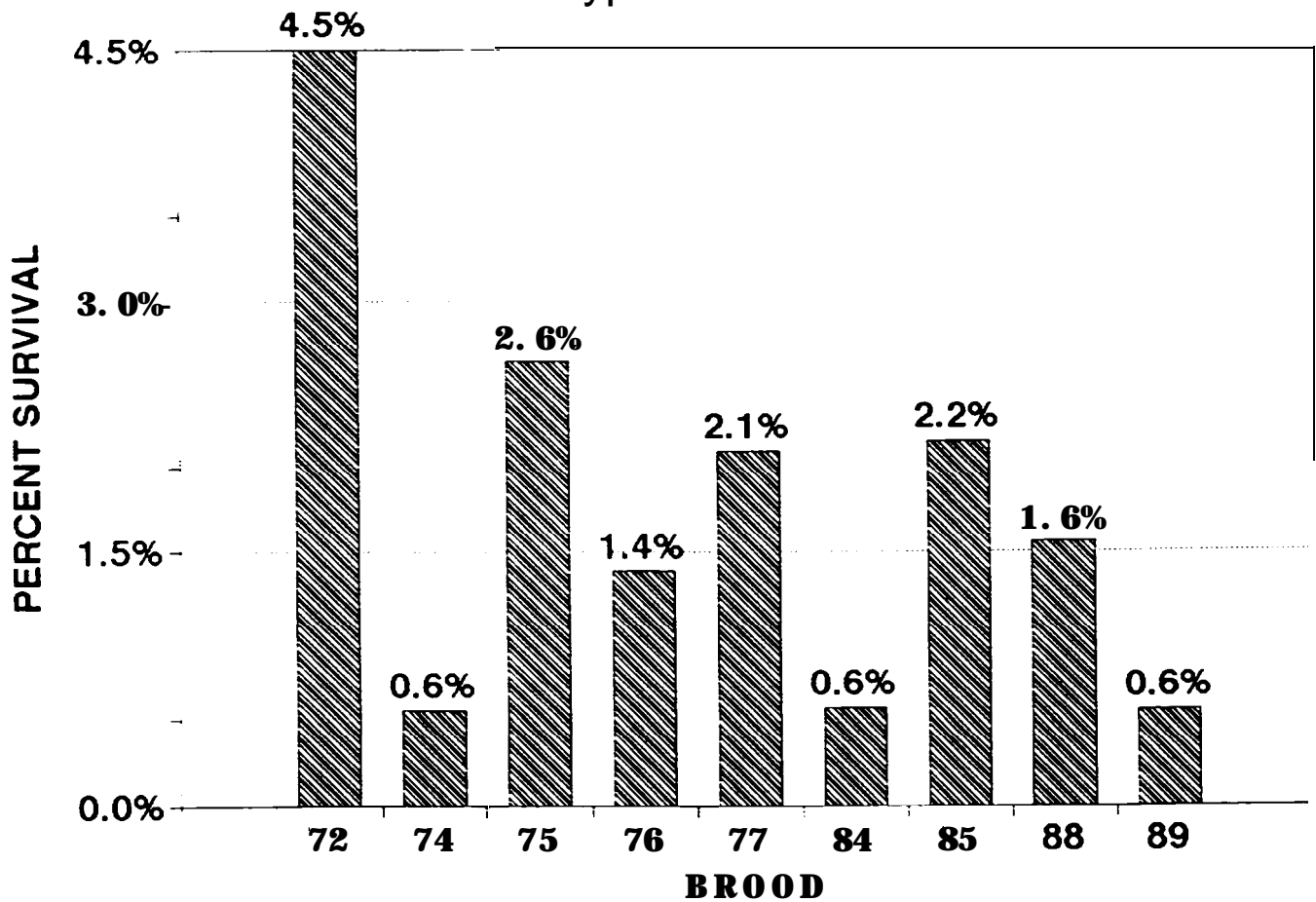


Figure 43. Survival of Klickitat Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Klickitat Hatchery Coho

Type-N Coho, 1988 & 1989 Broods

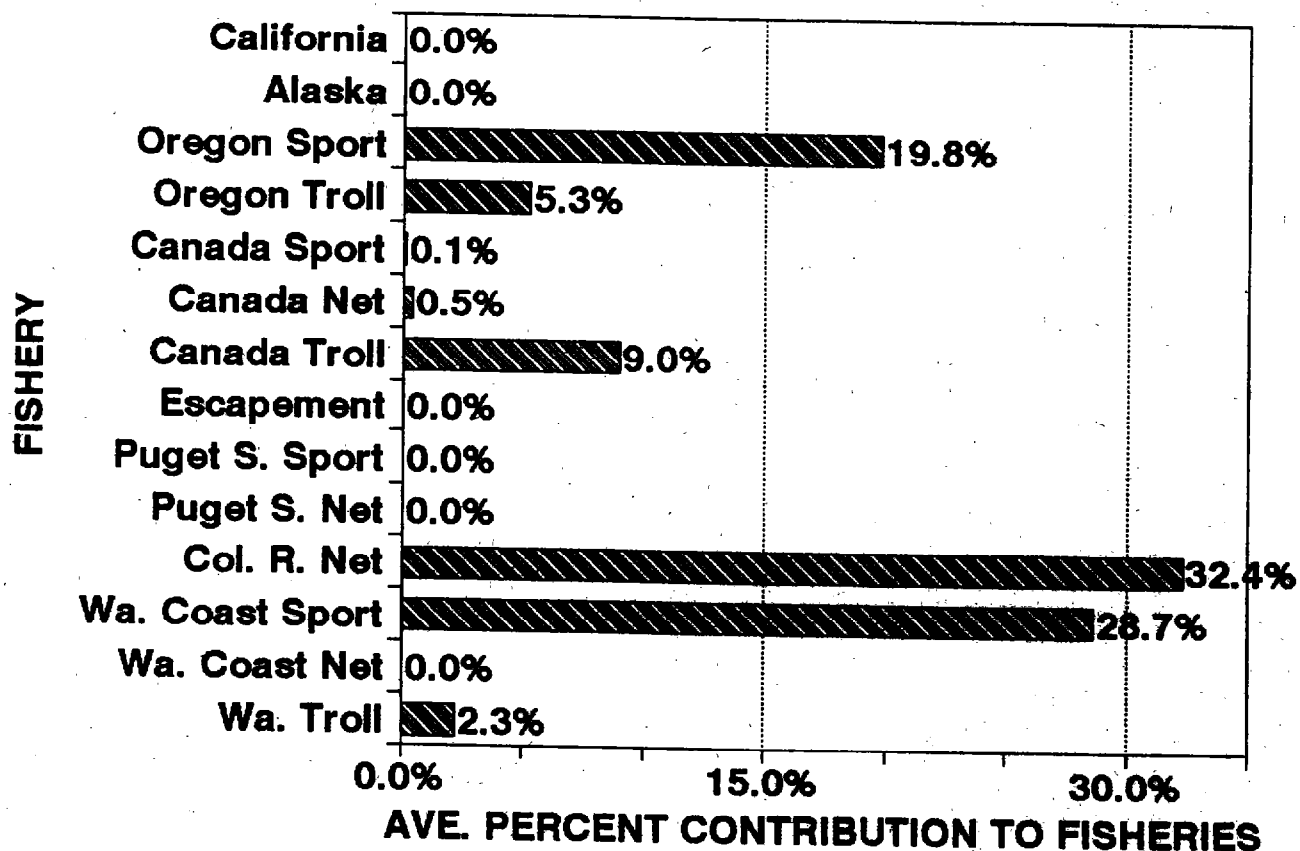


Figure 44. Average percent contribution of Klickitat Type-N coho to fisheries and escapement for broods 1988 and 1989.

Lyons Ferry Hatchery Fall Chinook Subyearlings only

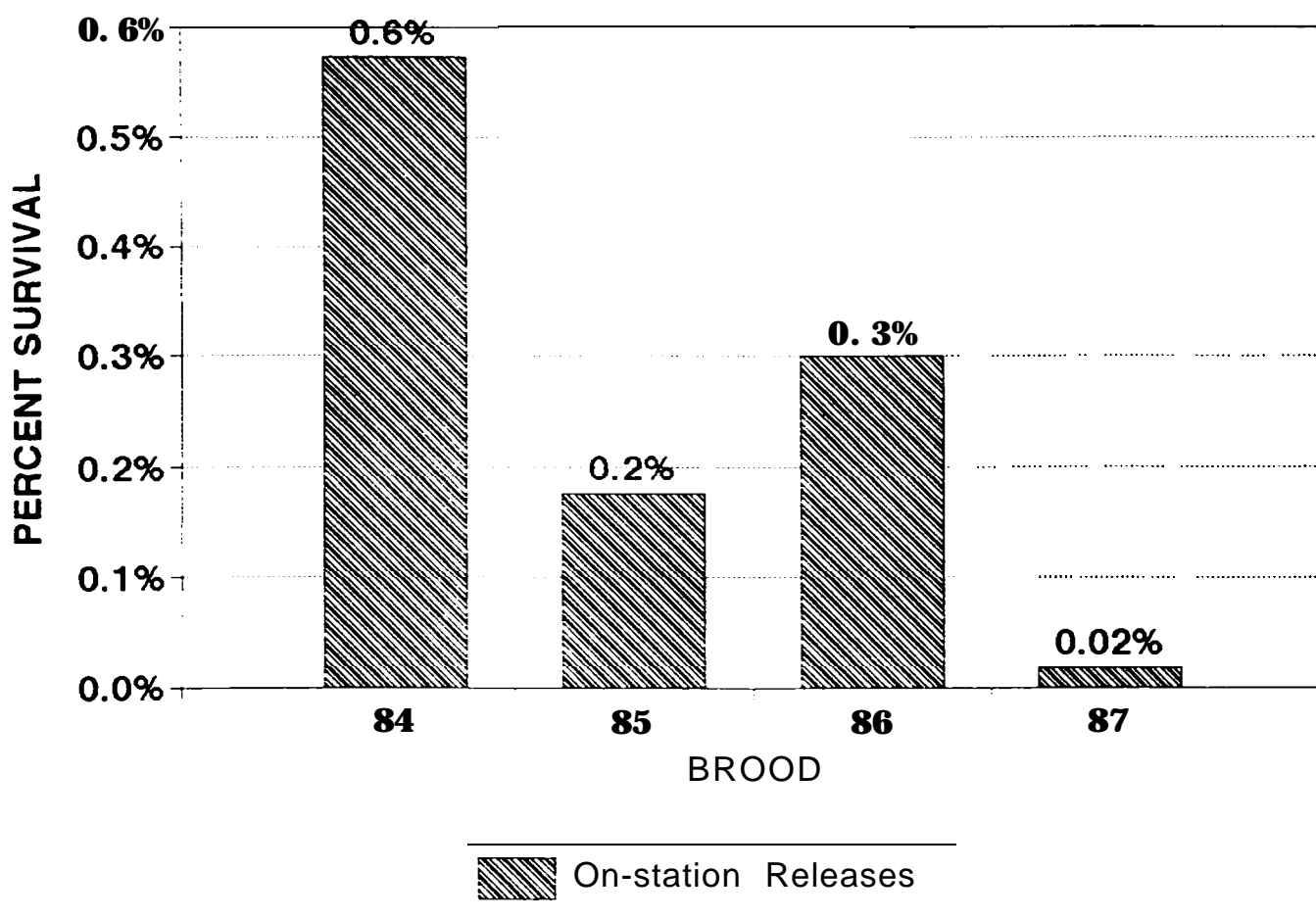


Figure 45. Average survival by brood of Lyons Ferry (Snake River) subyearling fall chinook released on-station.

Lyons Ferry Hatchery Fall Chinook Subyearling Releases, 1986 & 1987 Broods

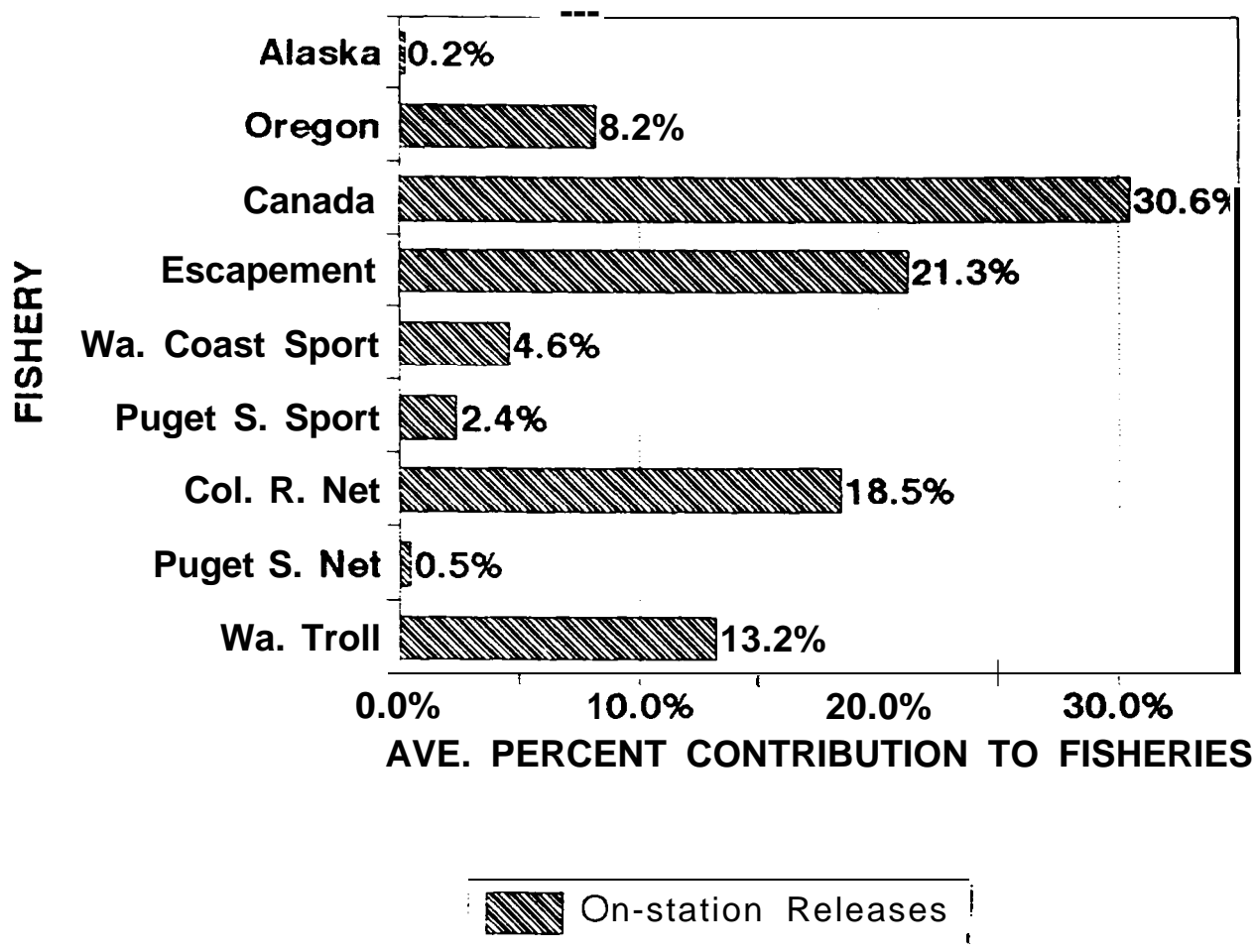


Figure 46. Average percent contribution of Lyons Ferry subyearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released on-station.

Lyons Ferry Hatchery Fall Chinook Subyearlings only

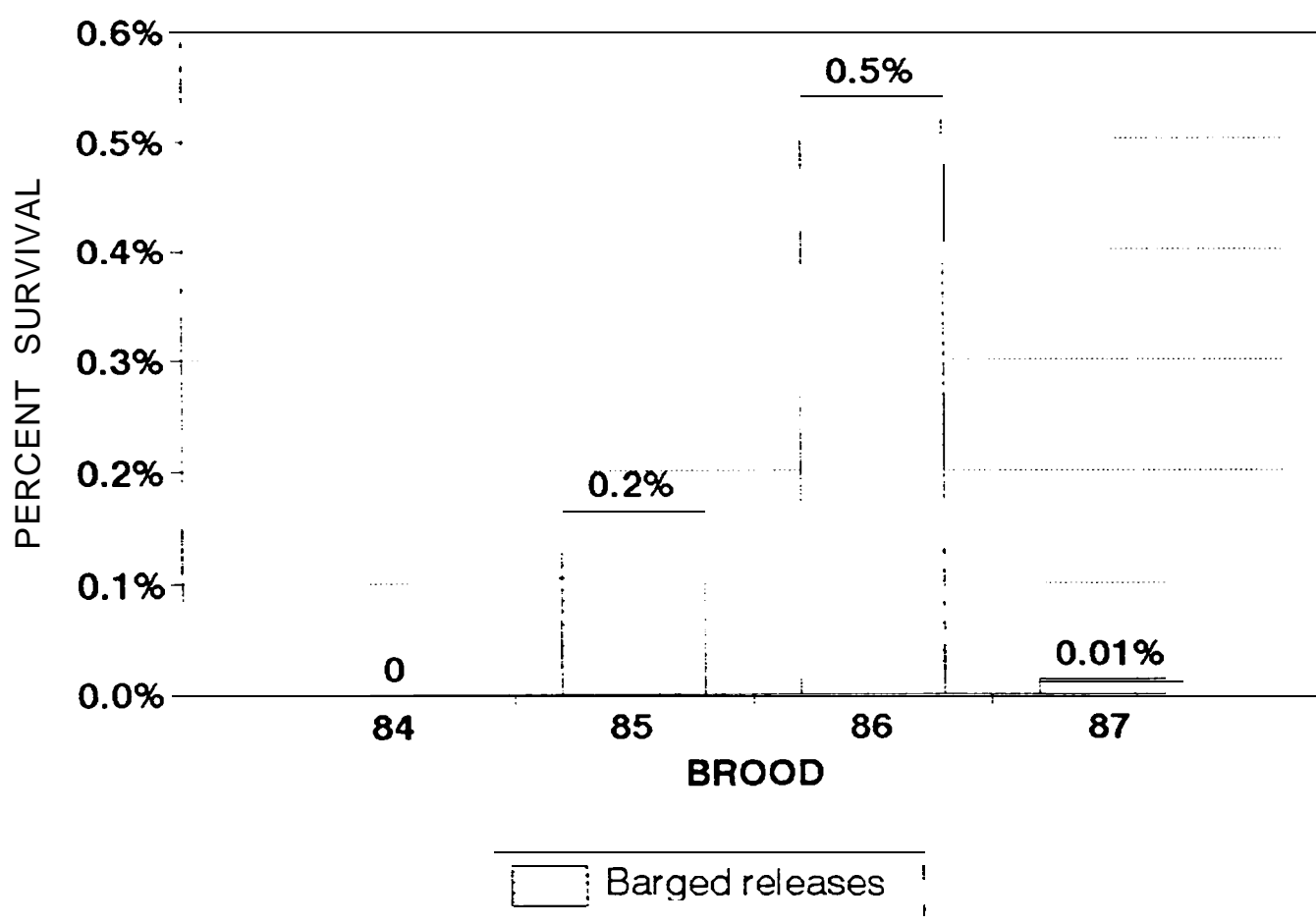


Figure 47. Average survival by brood of Lyons Ferry (Snake River) subyearling fall chinook released after barging downstream.

Lyons Ferry Hatchery Fall Chinook Subyearling Releases, 1986 & 1987 Broods

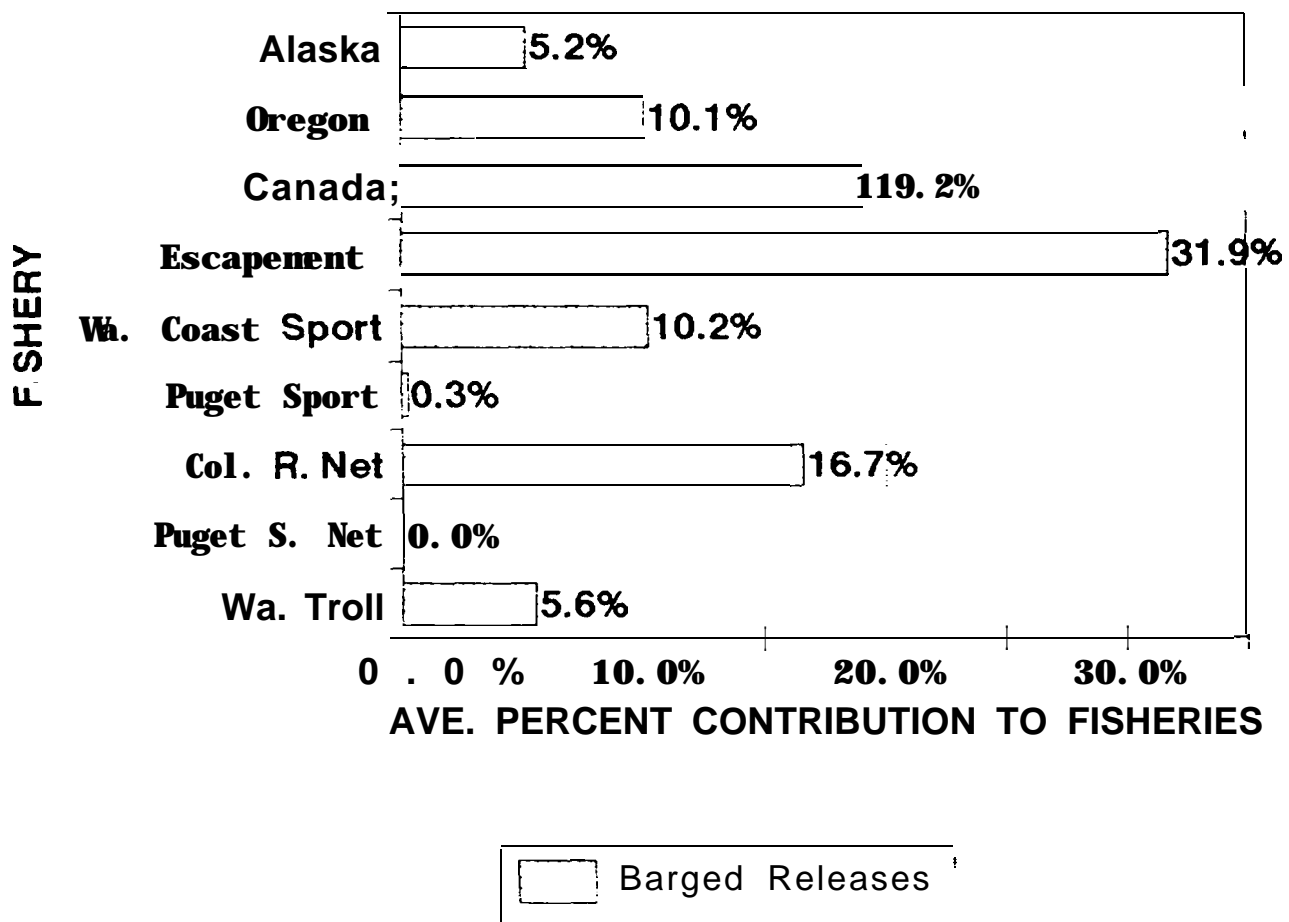


Figure 48. Average percent contribution of Lyons Ferry subyearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released after barging.

Lyons Ferry Fall Chinook Yearlings only

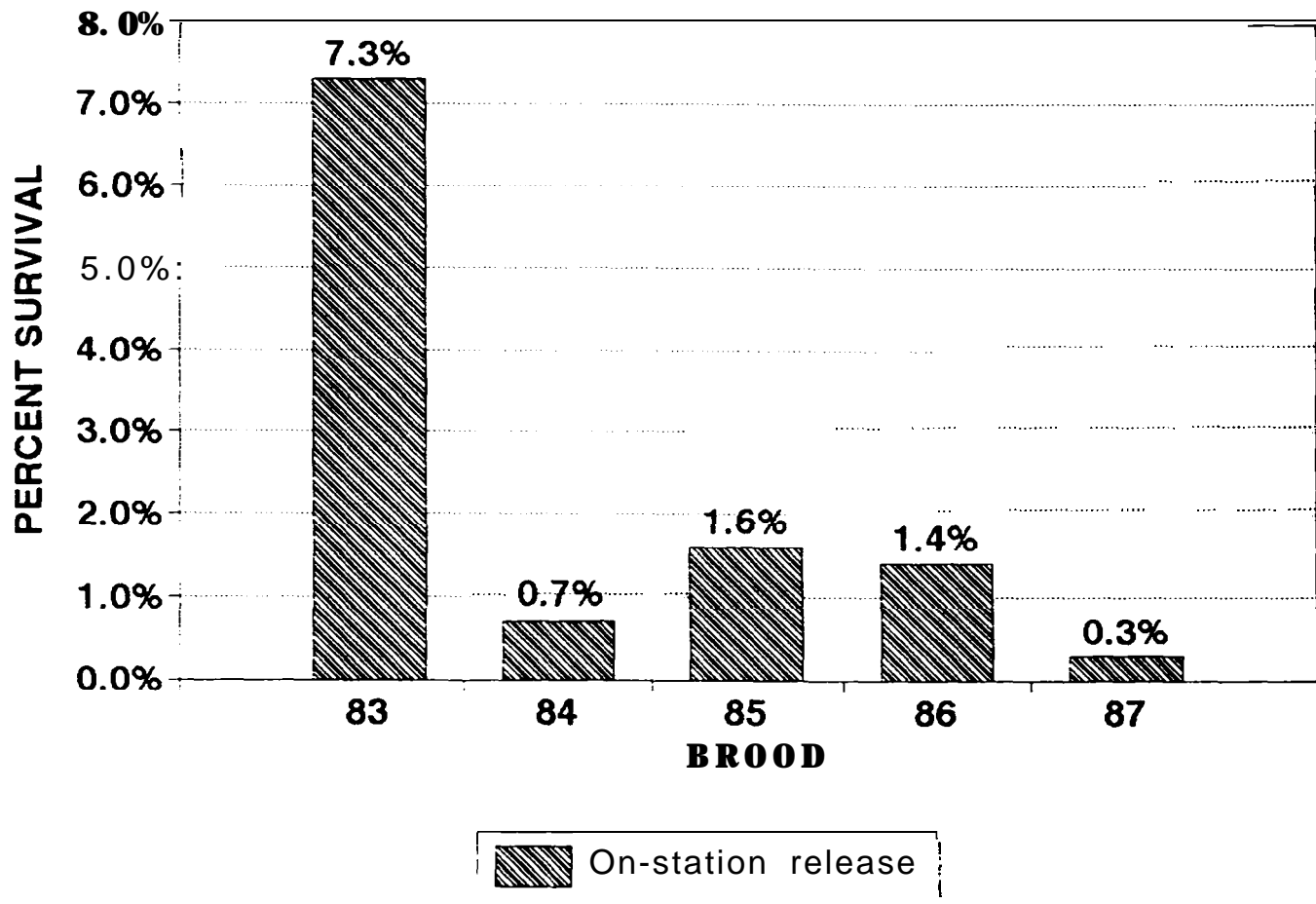


Figure 49. Average survival by brood of Lyons Ferry (Snake River) yearling fall chinook released on-station.

Lyons Ferry Hatchery Fall Chinook Yearling Releases, 1986 & 1987 Broods

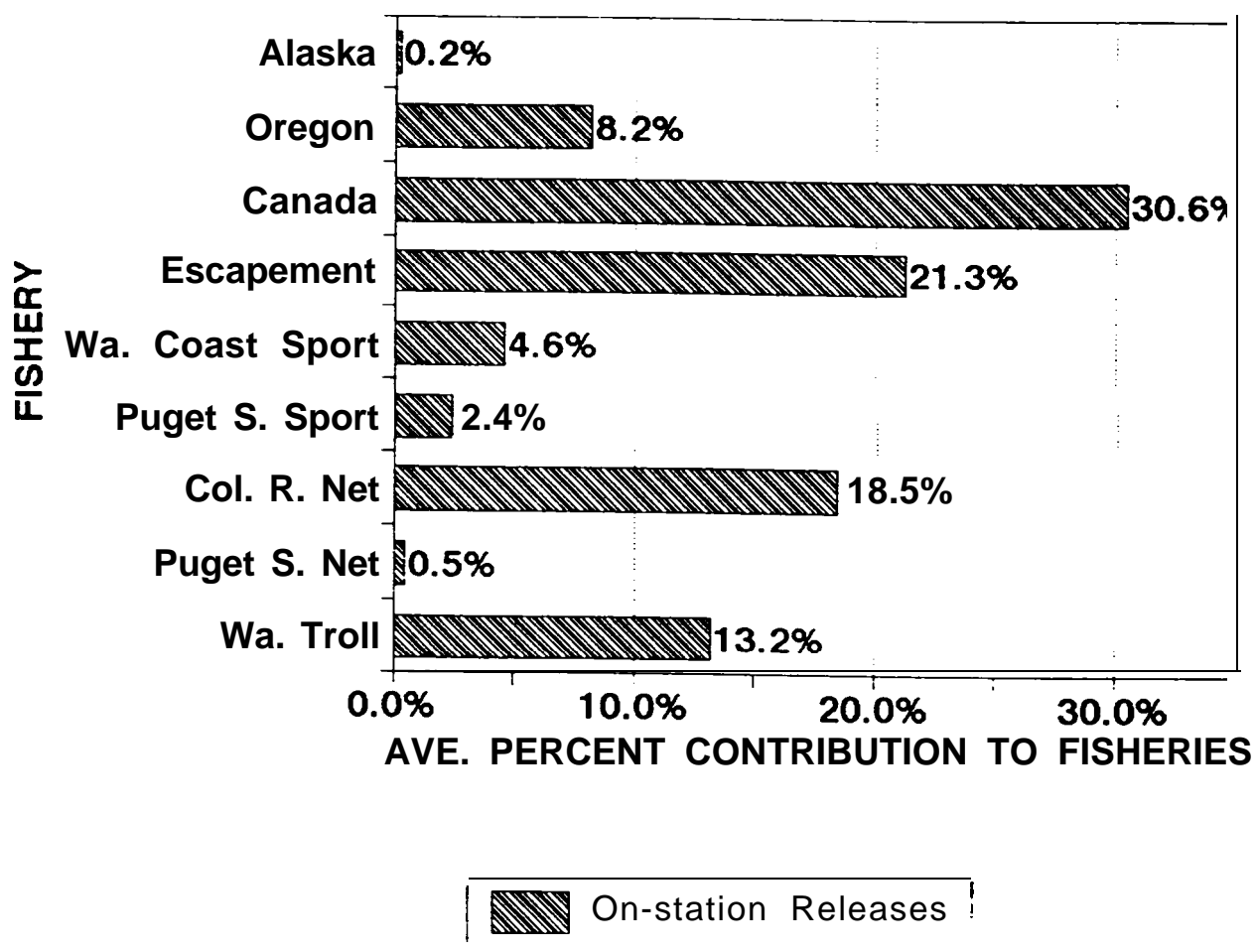


Figure 50. Average percent contribution of Lyons Ferry yearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released on-station.

Lyons Ferry Fall Chinook Yearlings only

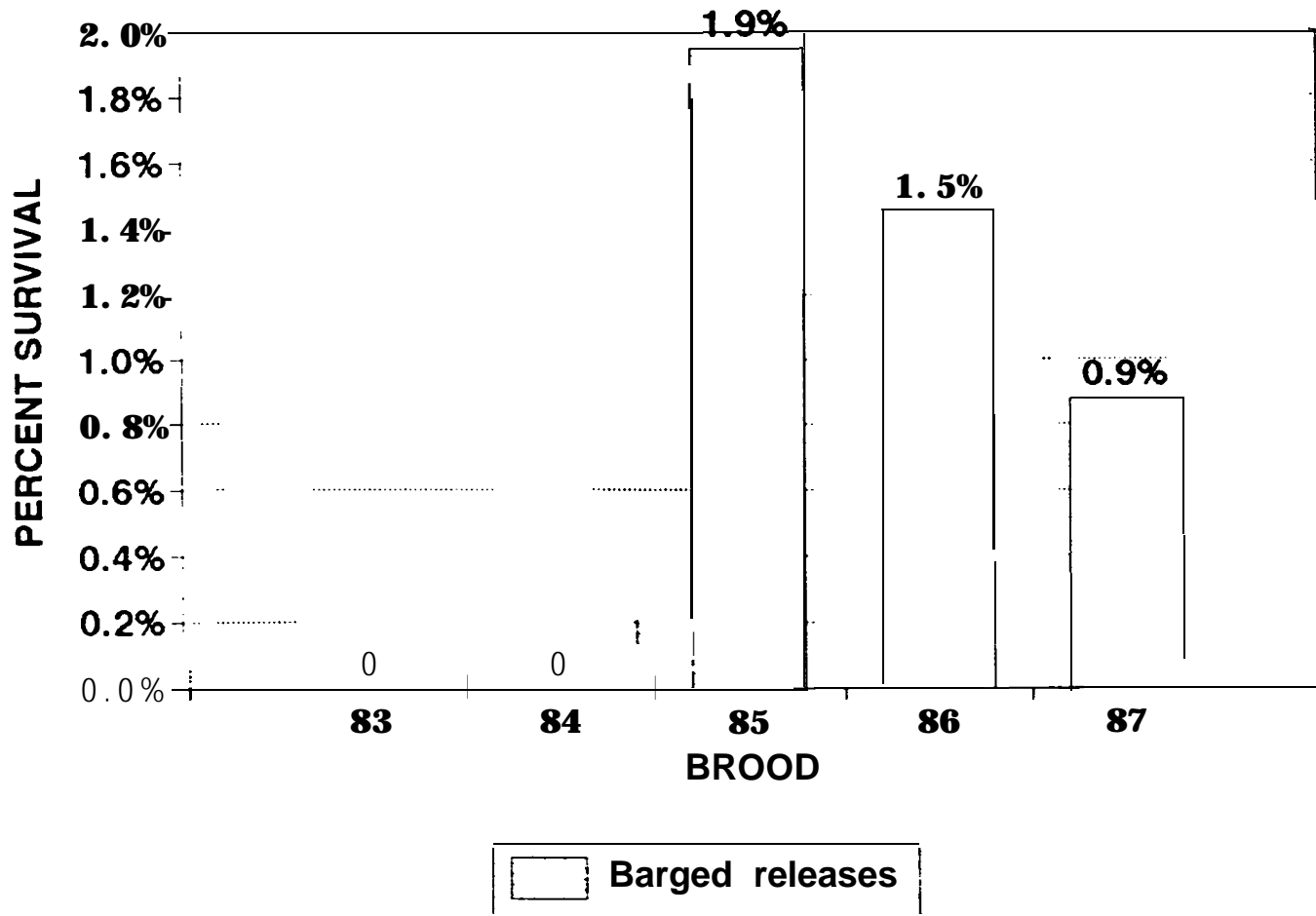


Figure 5 1. Average survival by brood of Lyons Ferry (Snake River) yearling fall chinook released after barging.

Lyons Ferry Hatchery Fall Chinook Yearling Releases, 1986 & 1987 Broods

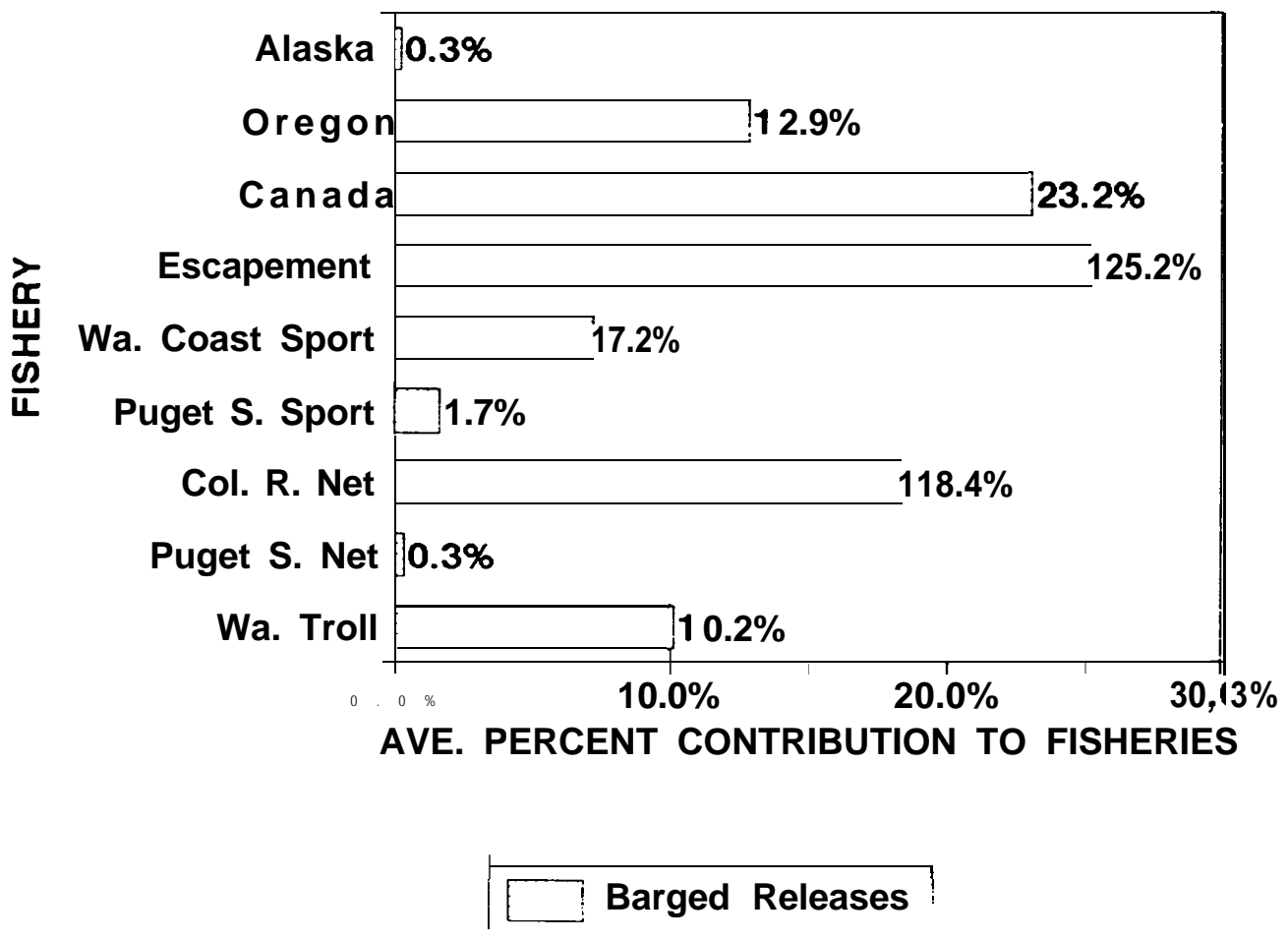


Figure 52. Average percent contribution of Lyons Ferry yearling fall chinook to fisheries and escapement for broods 1986 and 1987. Data for fish released after barging.

Tucannon Hatchery Spring Chinook Yearling Releases

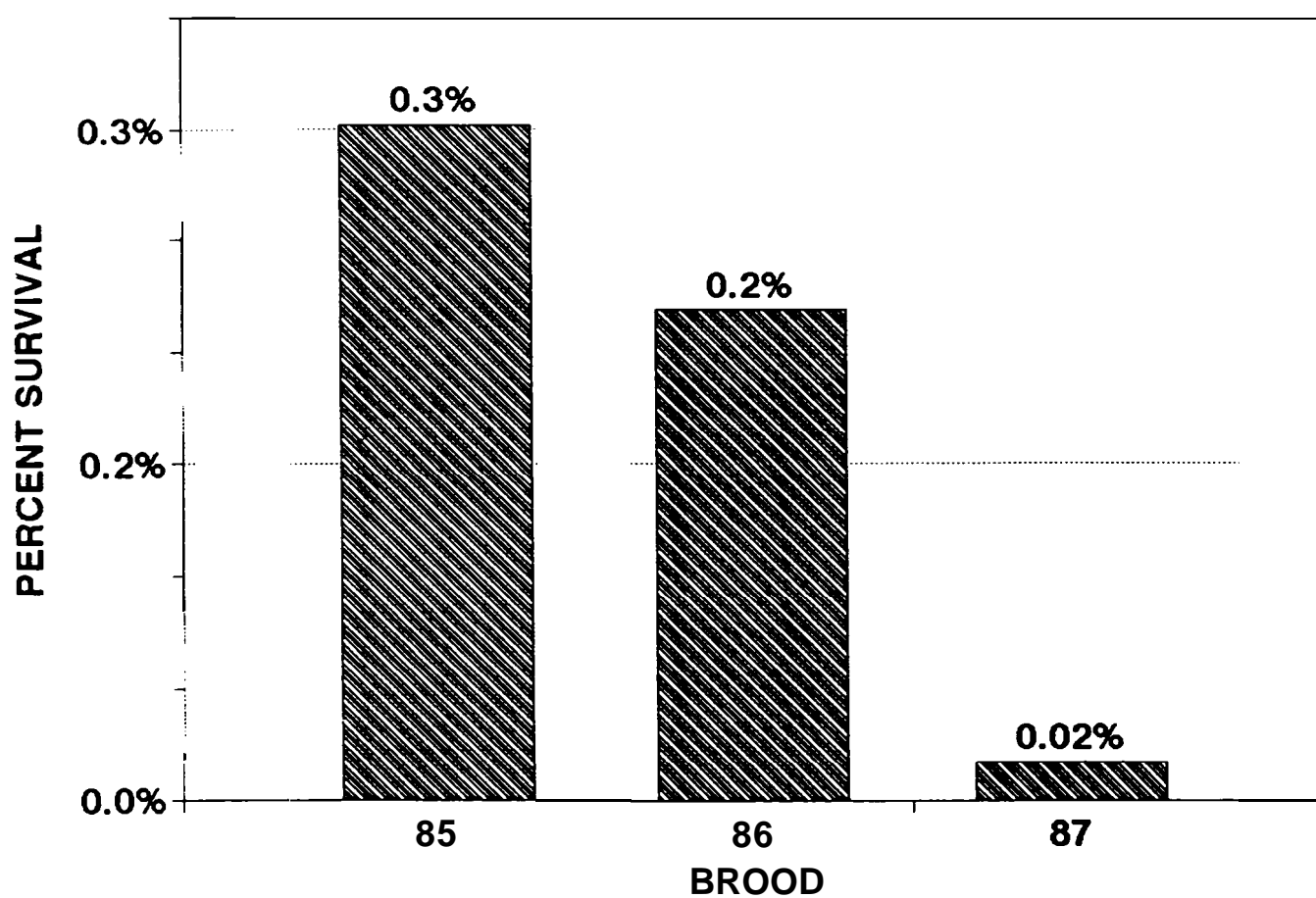


Figure 53. Average survival of Tucannon spring chinook by brood.

Tucannon Hatchery Spring Chinook Yearling Releases

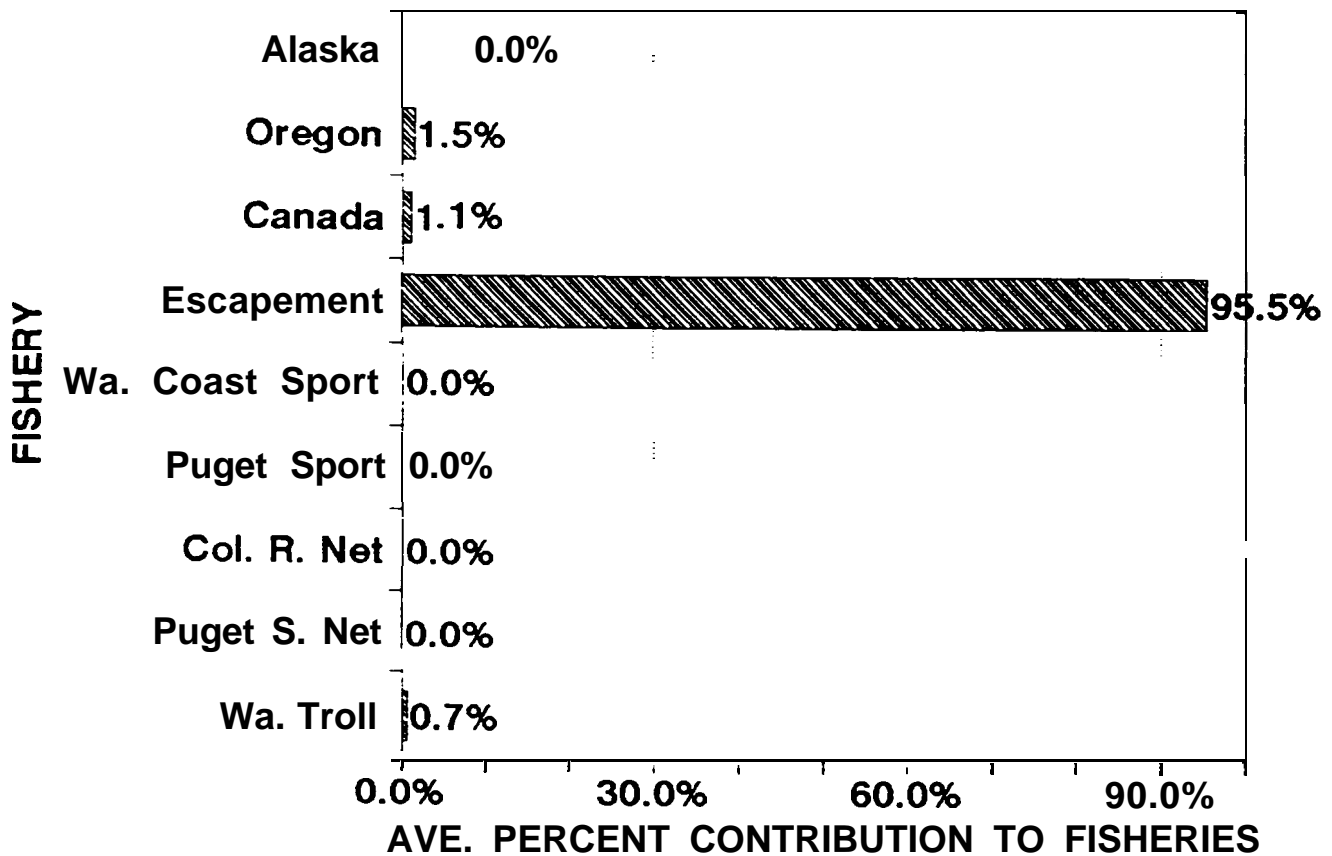


Figure 54. Average percent contribution of Tucannon spring chinook to fisheries and escapement for broods 1986 and 1987.

Ringold Hatchery Spring Chinook Yearling Releases

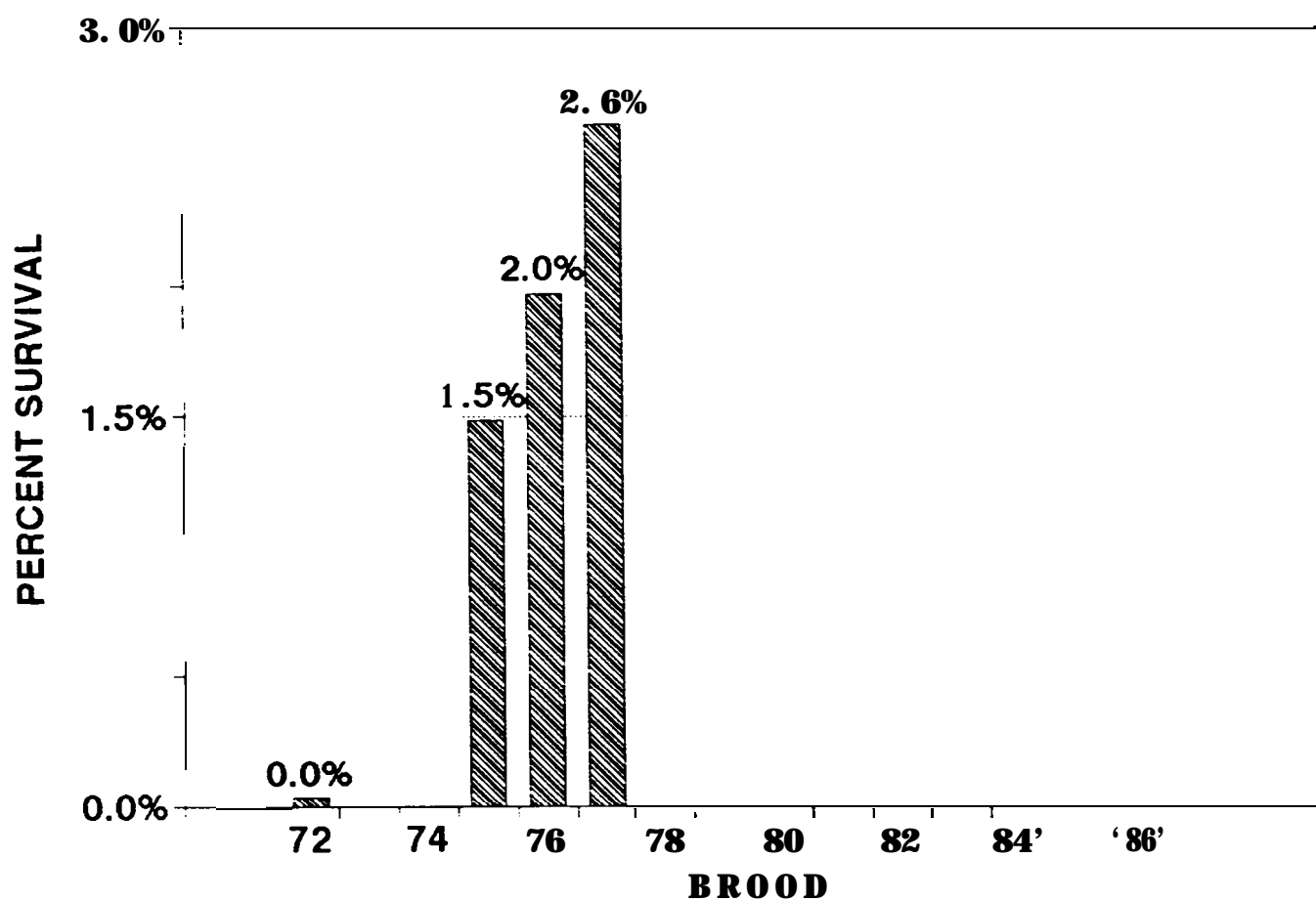


Figure 55. Survival of Ringold spring chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Priest Rapids Hatchery Fall Chinook Subyearlings only

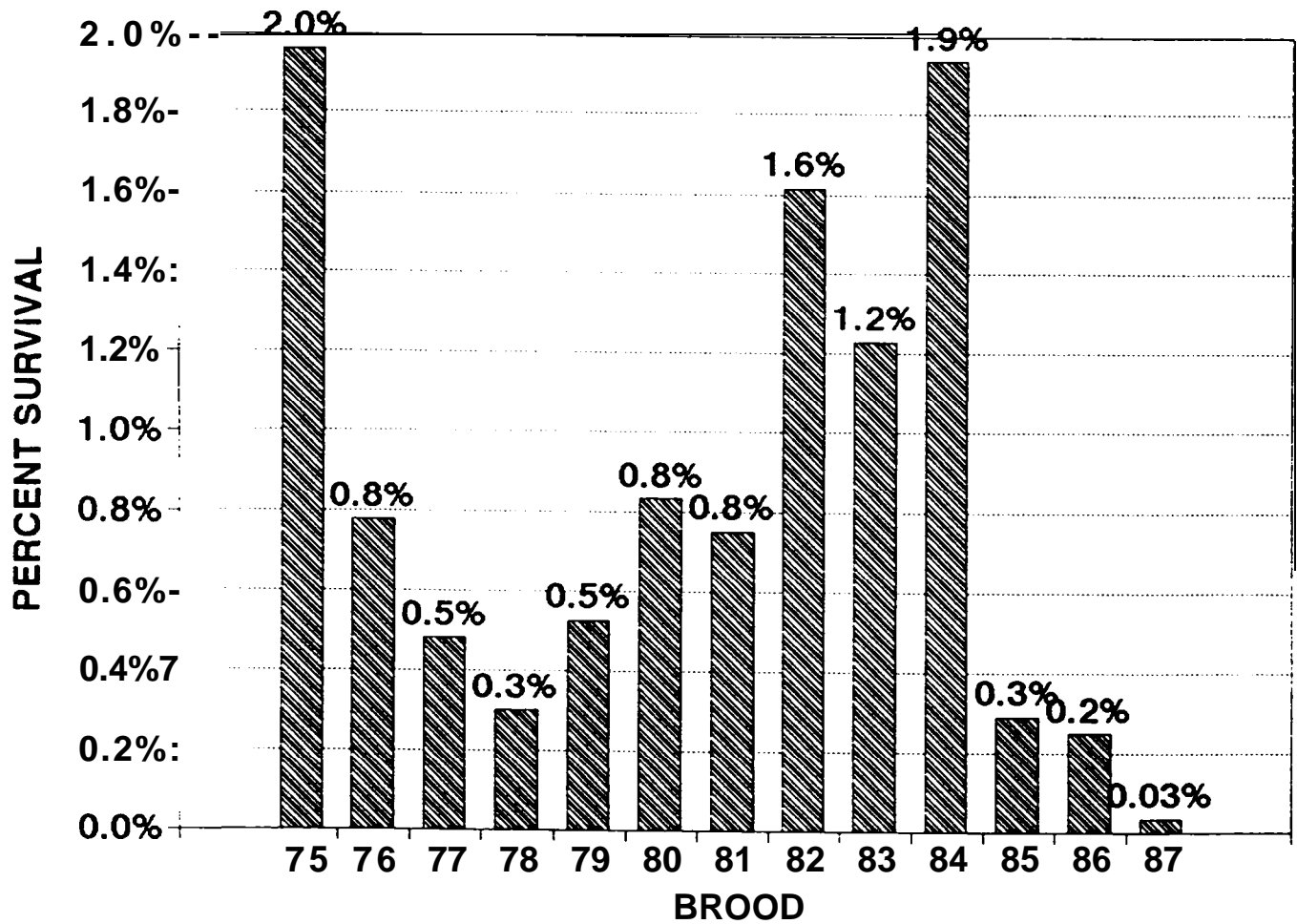


Figure 56. Survival of Priest Rapids upriver bright fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

Priest Rapids Hatchery Fall Chinook Subyearling Releases, 1986 & 1987 Broods

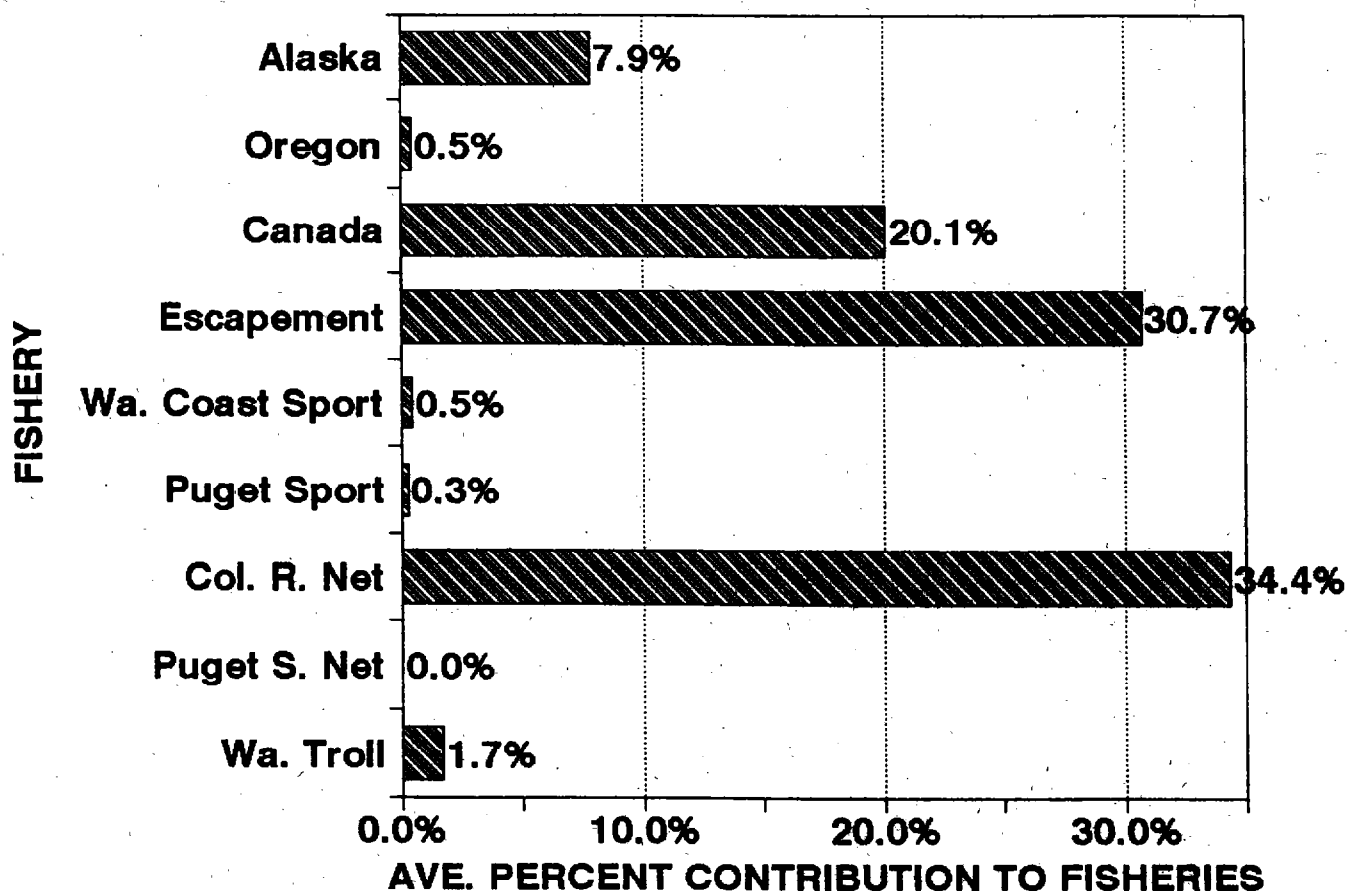


Figure 57. Average percent contribution of Priest Rapids fall chinook to fisheries and escapement for broods 1986 and 1987.

Rocky Reach Fall Chinook Yearlings only

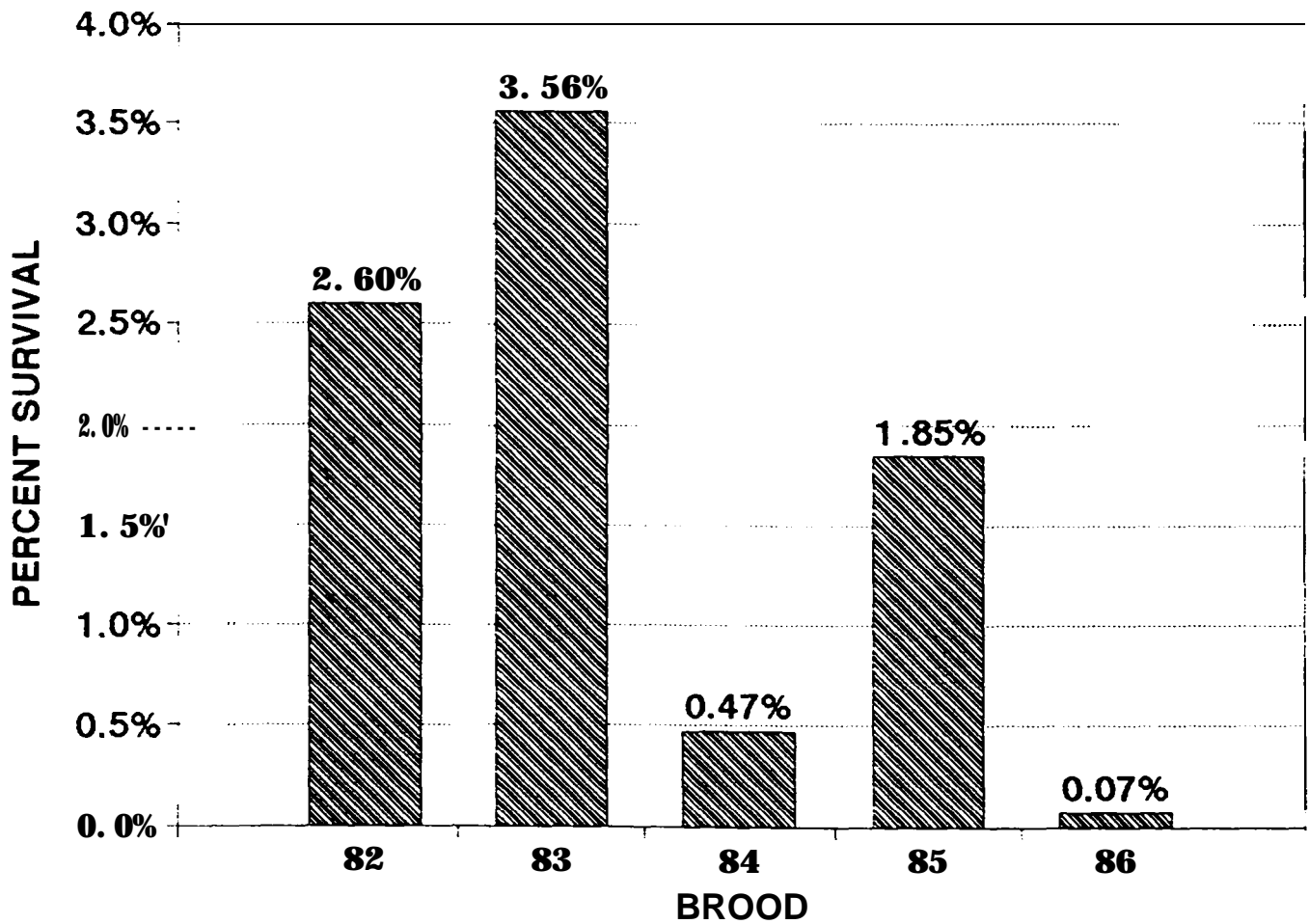


Figure 58. Survival of Rocky Reach upriver bright yearling fall chinook by brood.

Rocky Reach Fall Chinook Yearlings only, 1886

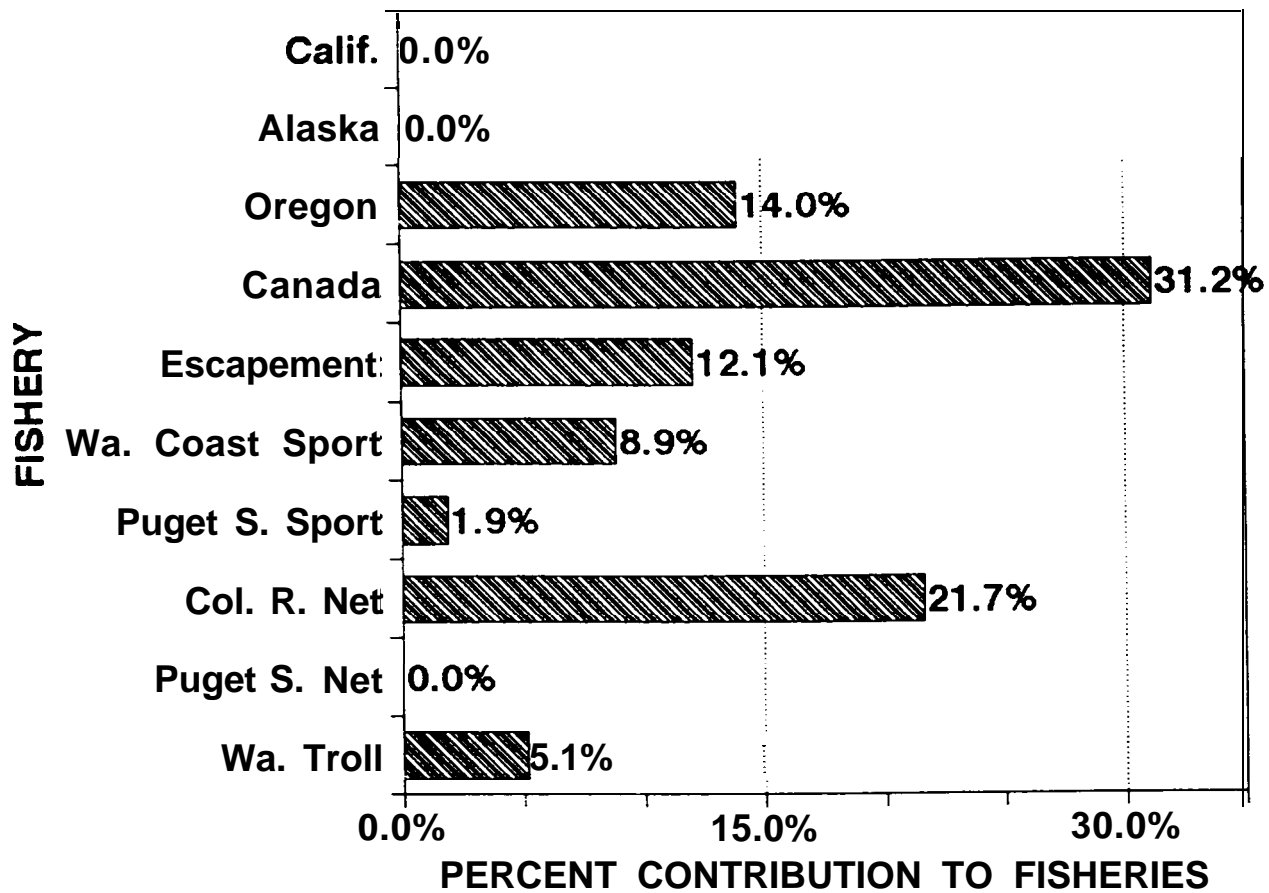


Figure 59. Percent contribution of 1886 brood Rocky Reach upriver bright yearling fall chinook to fisheries and escapement.

Rocky Reach Hatchery Coho

Type-S Coho

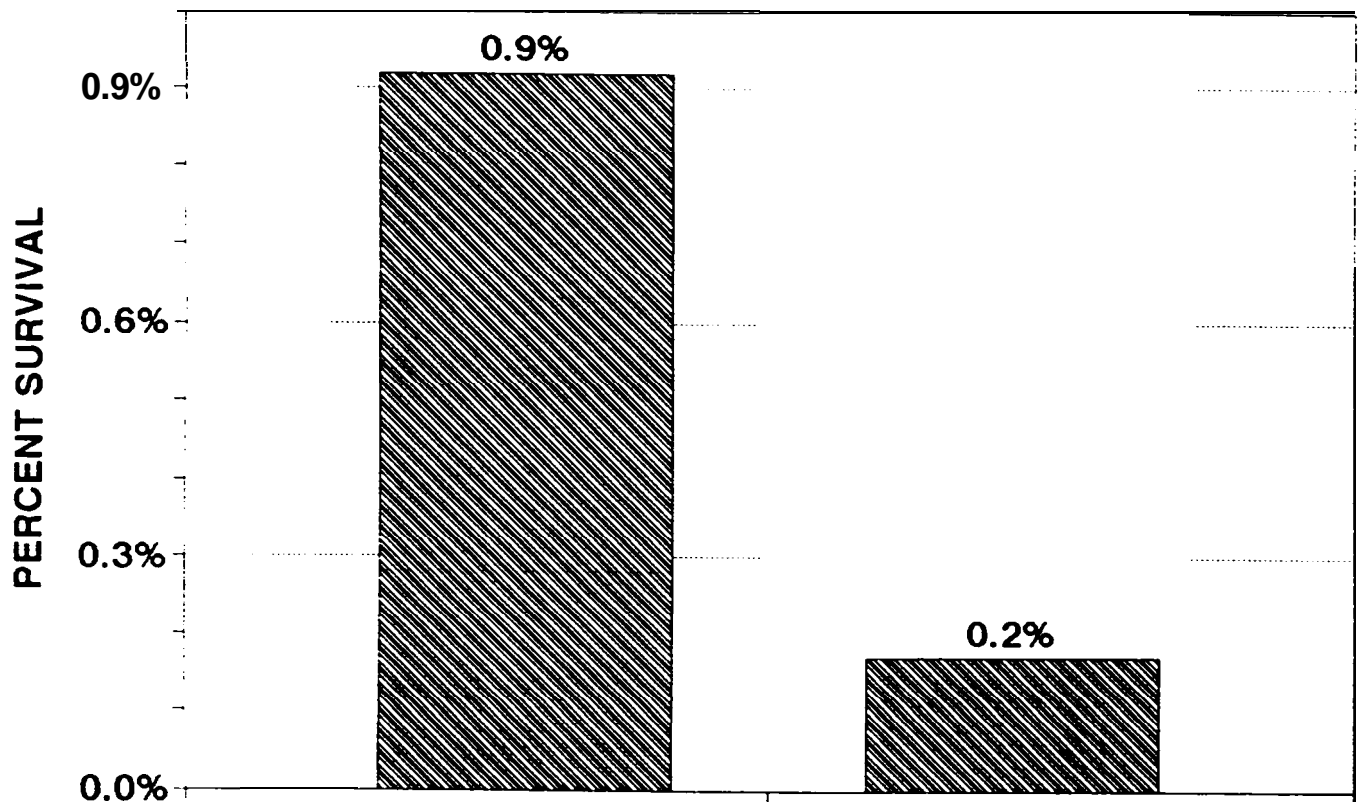


Figure 60. Survival of Rocky Reach Type-S coho by brood.

Rocky Reach Hatchery Coho

Type-S Coho, 1989 Brood

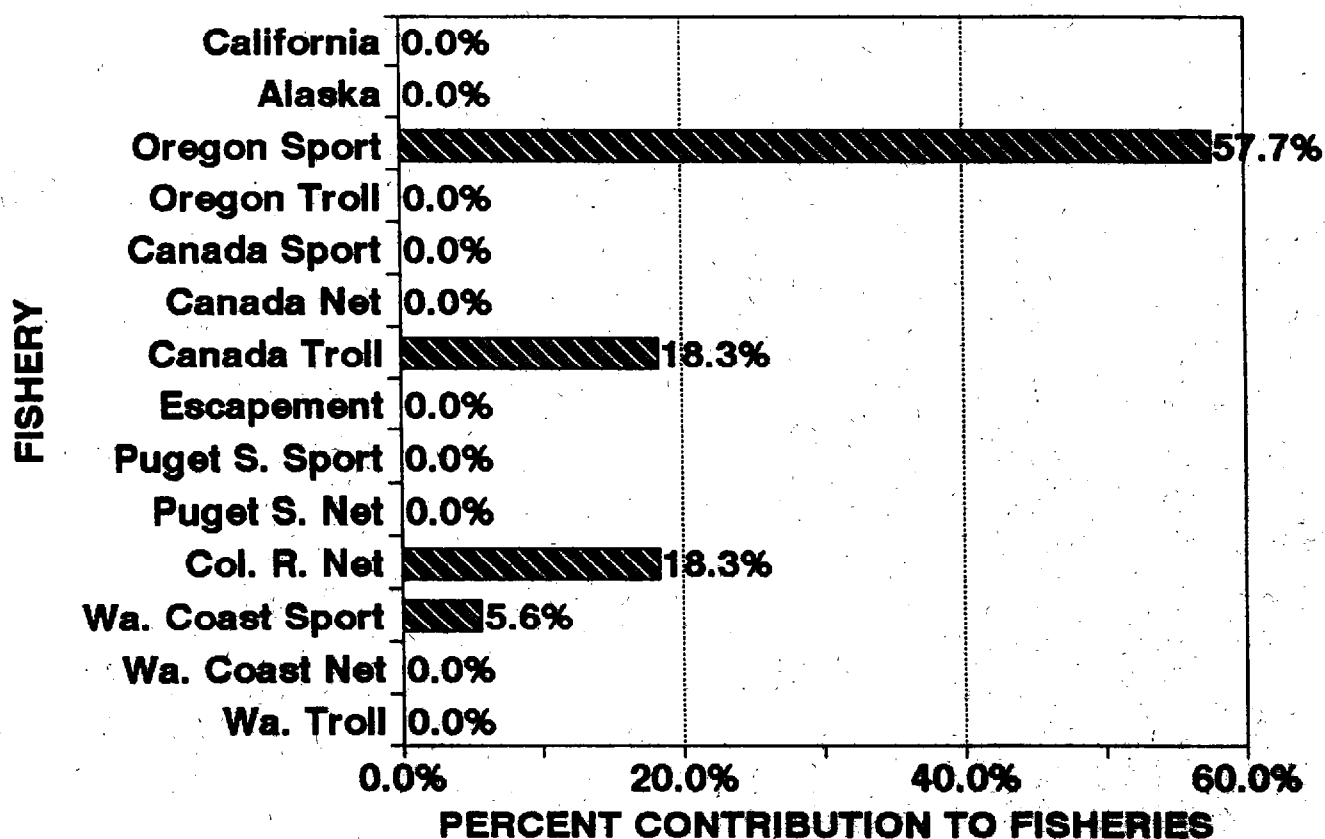


Figure 61. Percent contribution of 1989 brood Rocky Reach Type-S coho to fisheries and escapement.

Wells Dam Hatchery Summer Chinook Yearling Releases

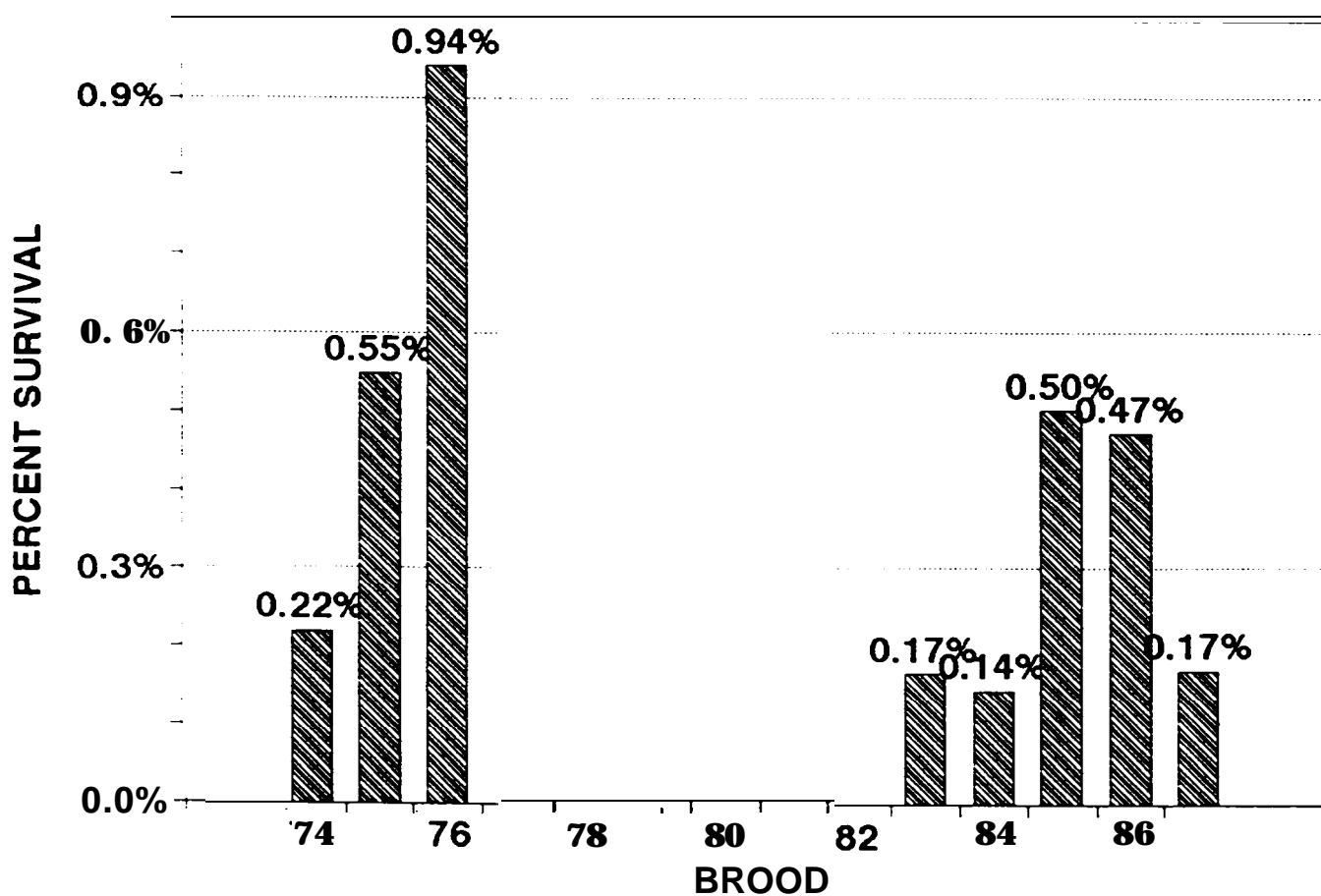


Figure 62. Survival of Wells Hatchery yearling summer chinook by brood.

Wells Dam Hatchery Summer Chinook Yearling Releases

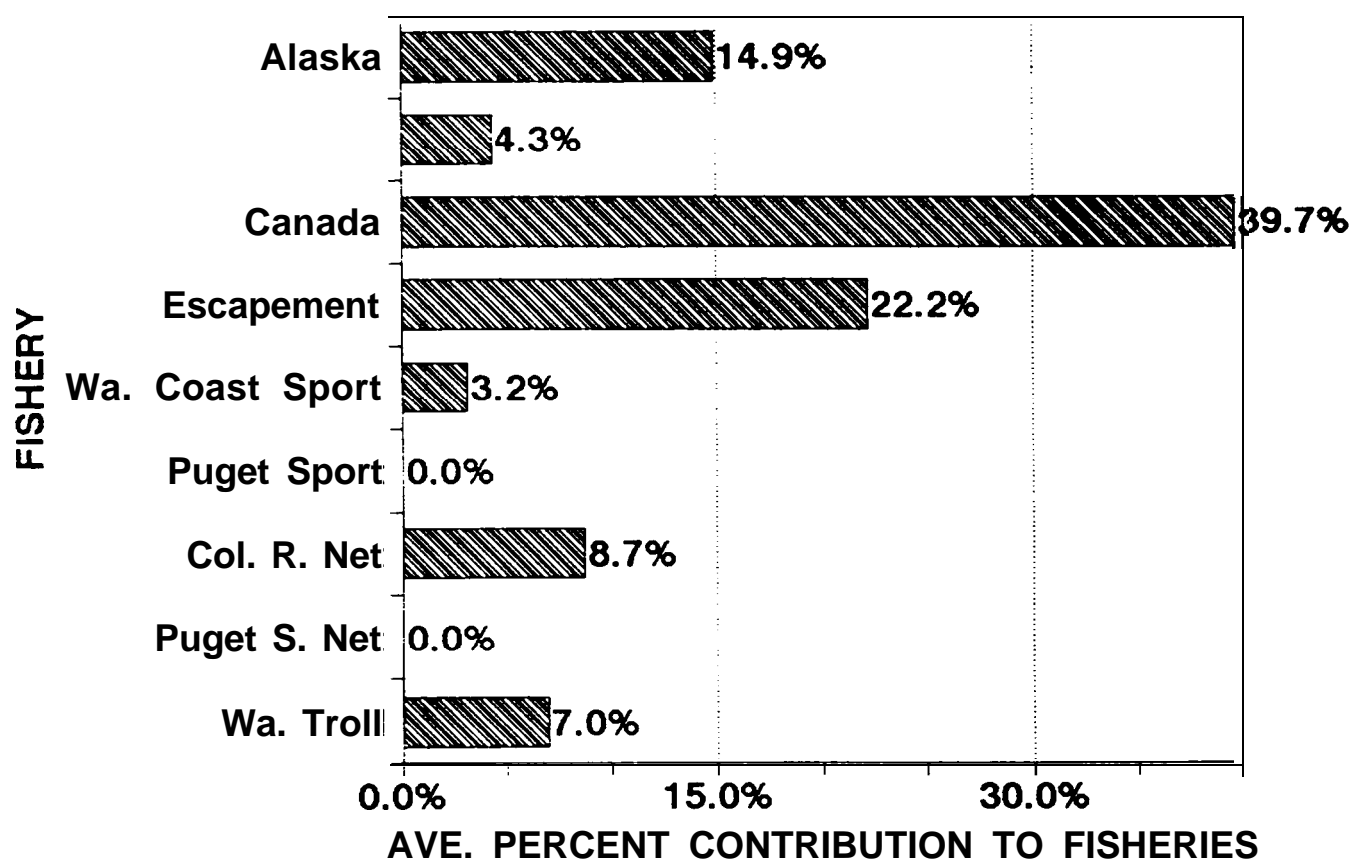


Figure 63. Average percent contribution of Wells Hatchery yearling summer chinook to fisheries and escapement for broods 1986 and 1987.

Wells Dam Hatchery Summer Chinook Sub-Yearling Releases

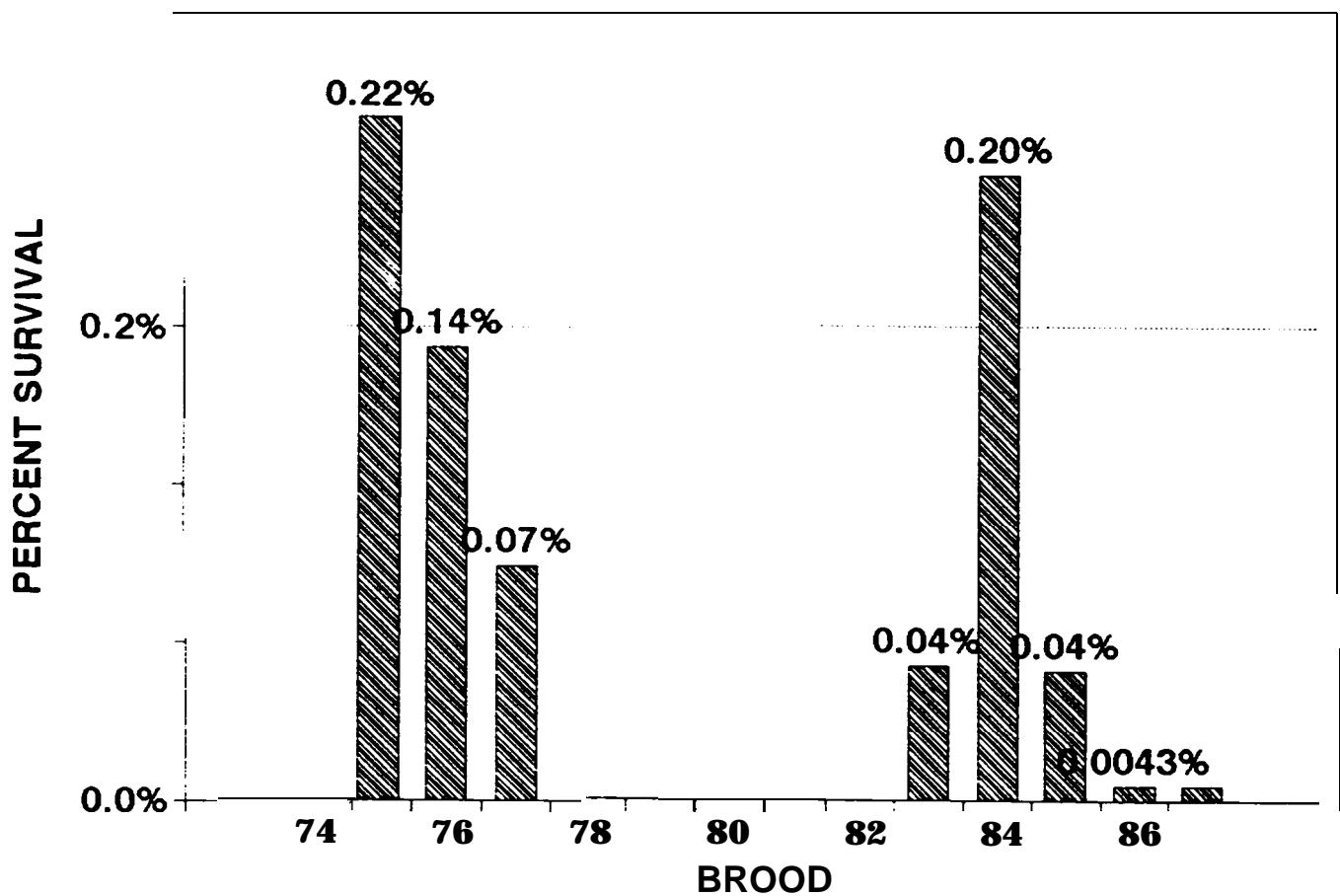


Figure 64. Survival of Wells Hatchery subyearling summer chinook by brood.

Wells Dam Hatchery Summer Chinook Sub-Yearling Releases, 1986&1 987 Broods

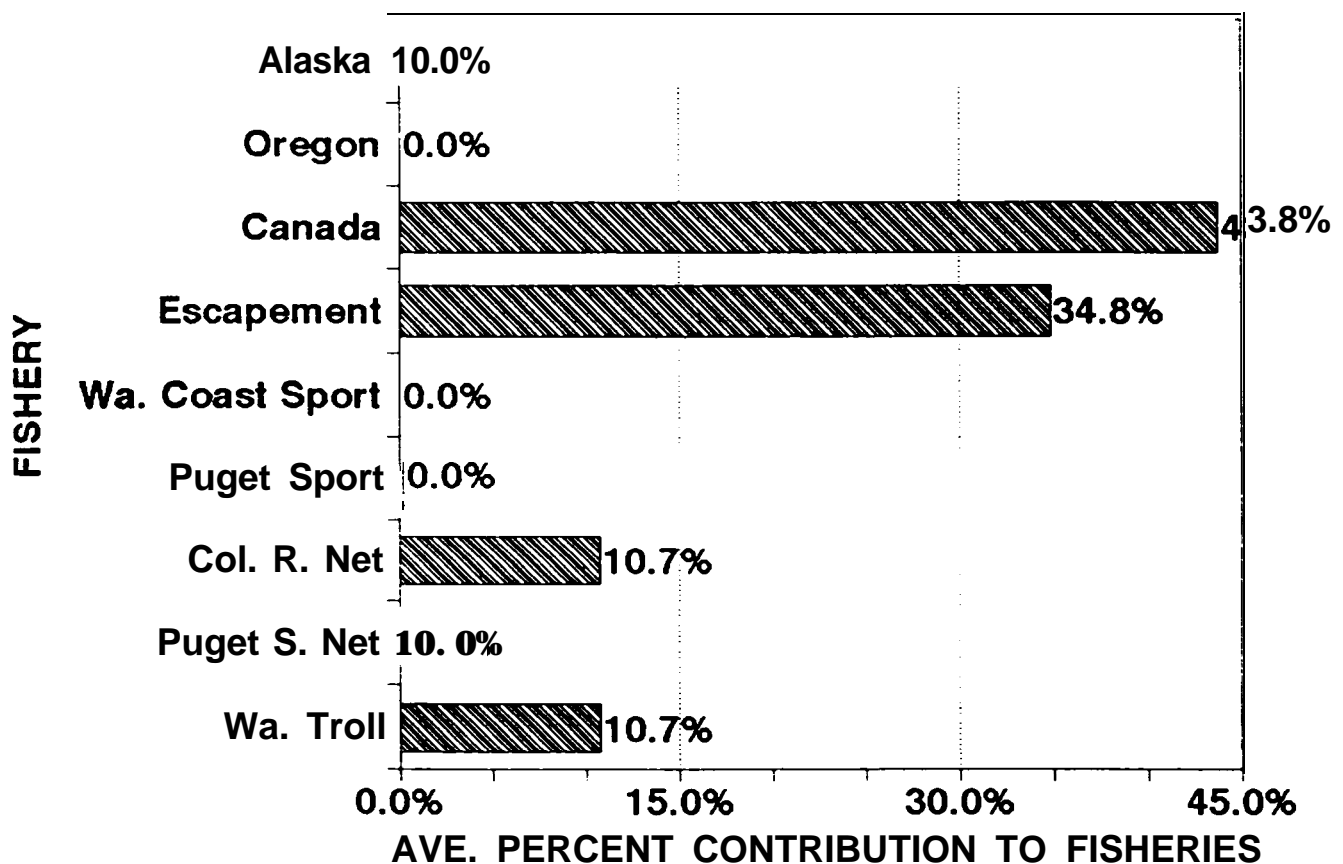


Figure 65. Average percent contribution of Wells Hatchery subyearling summer chinook to fisheries and escapement for broods 1986 and 1987.